HERITAGE IMPACT ASSESSMENT: PROPOSED GRID CONNECTION INFRASTRUCTURE FOR THE NAMAS WIND FARM, NAMAKWALAND MAGISTERIAL DISTRICT, NORTHERN CAPE

Required under Section 38 (8) of the National Heritage Resources Act (No. 25 of 1999).

SAHRA Case No.: 13835

Report for:

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EXECUTIVE SUMMARY

ASHA Consulting (Pty) Ltd has been appointed by Savannah Environmental (Pty) Ltd to conduct an assessment of the potential impacts to heritage resources that might occur through the proposed construction and operation of the grid infrastructure for the Namas Wind Farm, Namakwaland Magisterial District, Northern Cape Province. The properties affected by the proposal all fall within the Springbok Renewable Energy Development Zone (REDZ) and are listed below.

Farm portions (from south to north)
Remainder of Farm Rooivlei 327
Portion 3 of Farm Zonnekwa 328
Portion 2 of Farm Zonnekwa 328
Portion 1 of Farm Zonnekwa 326
Remainder of Farm Zonnekwa 326
Remainder of Kannabieduin 324
Remainder of Sand Kop 322
Remainder of Farm Mannels Vley 321
Remainder of Farm Dikgat 195
Remainder of Farm Honde Vlei 325
Portion 15 of Farm Dikgat 195

Genesis Namas Wind (Pty) Ltd proposes the construction and operation of a grid connection solution for the proposed Namas Wind Farm, near Kleinsee, Northern Cape Province. The grid connection solution will include the development of a double-circuit 132kV power line (known as the Rooivlei-Gromis 132kV double-circuit power line) and collector substation (known as the Rooivlei Substation) to connect the proposed Namas Wind Farm to the national grid. Other associated infrastructure will also be required for the grid connection solution, including access tracks/roads, administrative buildings and laydown areas.

A corridor 300m wide and 32km long is being assessed to allow for the optimisation of the grid and associated infrastructure and to accommodate environmental sensitivities. The grid infrastructure will be developed within the assessed 300m corridor. The height of the power line pylons will be up to 32m and the servitude width of the power line will be 31m. The extent of the Rooivlei Substation will be 100m x 200m and the capacity of the substation will be 132kV.

The study area (i.e. 300m corridor) is generally sandy with dunes in many areas. In the north there are large deflation hollows. Tracks and fences are sparse and the area is very minimally developed with the exception of mining activities in the far north. The 300m corridor traverses the Buffels River in the north.

Palaeontological materials were not observed along the 300m corridor but isolated fossil bones could occur within the various sand formations of the area. The 300m corridor does include a number of archaeological sites and some may require sampling if they are to be disturbed. Impacts to isolated fossils and unmarked graves are possible but cannot be predicted. No other significant impacts are expected.

It is recommended that the proposed grid connection infrastructure (including the double-circuit 132kV power line and the collector substation) be authorised subject to the following conditions

which should be included in the conditions of authorisation or the environmental management program as appropriate:

- An archaeologist should be appointed to conduct a final pre-construction survey of the approved layout (i.e. the route of the double-circuit 132kV power line and the location of the collector substation within the 300m corridor) at least 6 months prior to commencement of construction;
- A chance finds procedure must be implemented for the rescuing of any fossils discovered during construction;
- All work is to be carried out within the authorised construction footprint (i.e. 300m corridor). Any new areas, outside of the 300m corridor, that may need to be disturbed must be surveyed for archaeological sites prior to disturbance;
- Any disturbed areas not required during operation must be rehabilitated after construction; and
- If any archaeological material or human burials are uncovered during the course of development then work in the immediate area should be halted. The find would need to be reported to the heritage authorities and may require inspection by an archaeologist. Such heritage is the property of the state and may require excavation and curation in an approved institution.

Glossary

Background scatter: Artefacts whose spatial position is conditioned more by natural forces than by human agency

Early Stone Age: Period of the Stone Age extending approximately between 2 million and 200 000 years ago.

Handaxe: A bifacially flaked, pointed stone tool type typical of the Early Stone Age.

Holocene: The geological period spanning the last approximately 10-12 000 years.

Hominid: a group consisting of all modern and extinct great apes (i.e. gorillas, chimpanzees, orangutans and humans) and their ancestors.

Heuweltjie: An ancient termite mound that now forms part of the dorbank horizon.

Later Stone Age: Period of the Stone Age extending over the last approximately 20 000 years.

Middle Stone Age: Period of the Stone Age extending approximately between 200 000 and 20 000 years ago.

Pleistocene: The geological period beginning approximately 2.5 million years ago and preceding the Holocene.

Abbreviations

APHP: Association of Professional Heritage Practitioners

ASAPA: Association of Southern African Professional Archaeologists

BAR: Basic Assessment Report

CCS: crypto-crystalline silica

CRM: Cultural Resources Management

ECO: Environmental Control Officer

EIA: Environmental Impact Assessment

ESA: Early Stone Age

GP: General Protection

GPS: global positioning system

HIA: Heritage Impact Assessment

LSA: Later Stone Age

MSA: Middle Stone Age

NBKB: Ngwao-Boswa Ya Kapa Bokoni

NEMA: National Environmental Management Act (No. 107 of 1998)

NHRA: National Heritage Resources Act (No. 25) of 1999

PPP: Public Participation Process

REDZ: Renewable Energy Development Zones

SAHRA: South African Heritage Resources Agency

SAHRIS: South African Heritage Resources Information System

Contents

1. INTRODUCTION

ASHA Consulting (Pty) Ltd has been appointed by Savannah Environmental (Pty) Ltd to conduct an assessment of the potential impacts to heritage resources that might occur through the proposed construction and operation of the grid infrastructure for the Namas Wind Farm, Namakwaland Magisterial District, Northern Cape Province (Figure 1). The properties affected by the proposal are listed in Table 1. The double-circuit 132kV power line would link a proposed wind farm[1] to the Gromis Substation just north of the Buffels River.

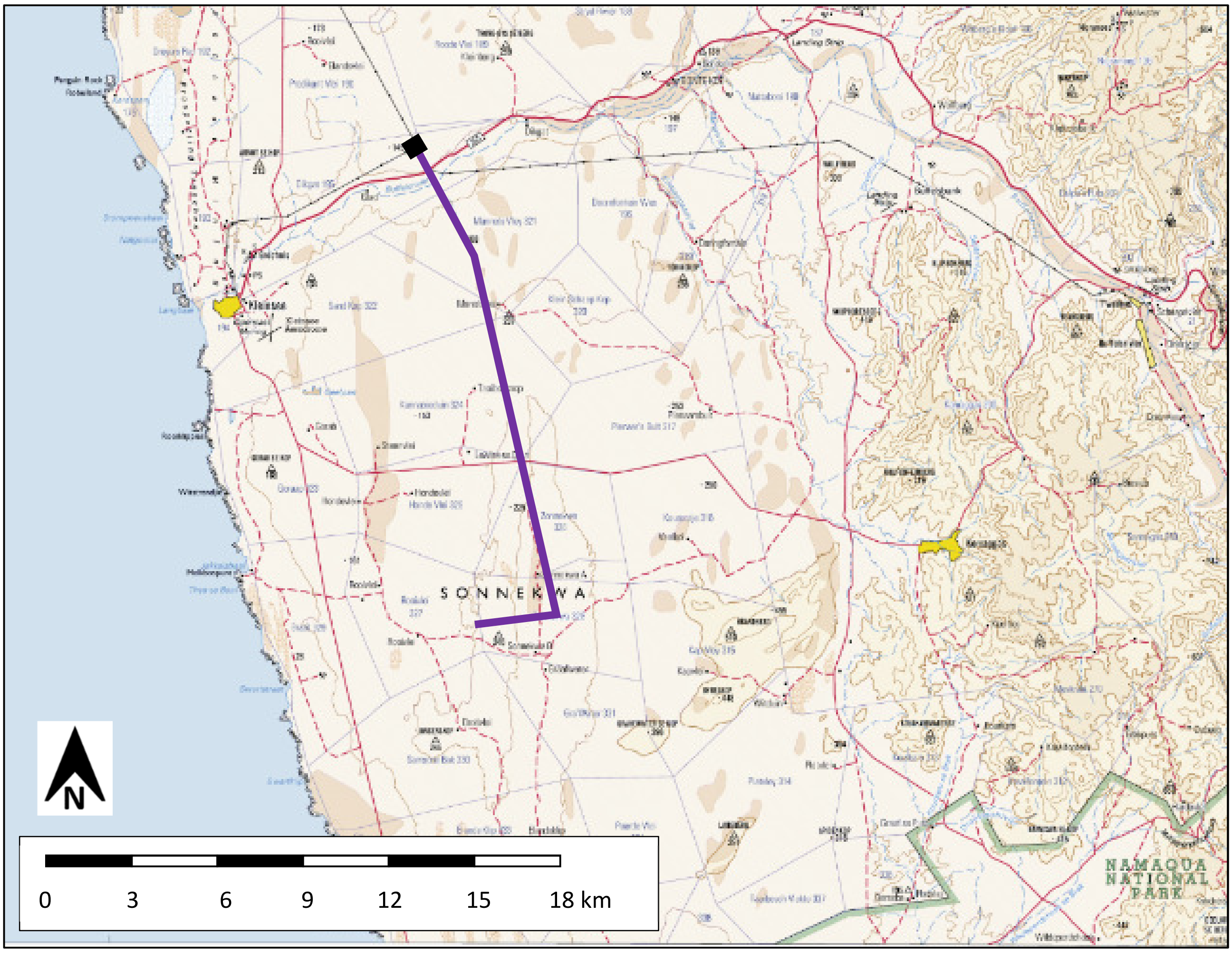

Figure 1: *Extract from 1:250 000 topographic map 2916 showing the location of the site. The purple line is the 300m corridor which runs northwards from a wind farm site to the Gromis Substation (black square). Source: Chief Directorate: National Geo-Spatial Information. Website: www.ngi.gov.za.*

[1] The wind farm is assessed within a separate application for Environmental authorisation.

Table 1: *List of properties affected by the proposed project.*

Farm portions (from south to north)
Remainder of Farm Rooivlei 327
Portion 3 of Farm Zonnekwa 328
Portion 2 of Farm Zonnekwa 328
Portion 1 of Farm Zonnekwa 326
Remainder of Farm Zonnekwa 326
Remainder of Kannabieduin 324
Remainder of Sand Kop 322
Remainder of Farm Mannels Vley 321
Remainder of Farm Dikgat 195
Remainder of Farm Honde Vlei 325
Portion 15 of Farm Dikgat 195

1.1. Project description

Genesis Namas Wind (Pty) Ltd is proposing the development of an approximately 32km long overhead 132kV power line (assessed as a 300m power line corridor), with a servitude of 31m, to connect the proposed Namas Wind Farm wind farm to the existing Gromis Substation located east of Kleinzee and just north of the Buffels River. The pylons would be up to 32m high. A 132kV substation will also be required and would be situated within the corridor near its southern end. It would have a footprint of 100m by 200m. The proposed corridor is shown in Figure 2.

Two grid connection options exist within the 300m corridor, namely:

» A direct connection from the proposed Rooivlei Substation to the existing Gromis Substation located ~26km from the northern boundary of the Namas Wind Farm project site. This is considered to be the preferred option from a technical perspective due to the fact that the Gromis Substation is already existing.
» A direct connection from the Rooivlei Substation to the proposed collector substation (known as the Strandveld Substation) which forms part of the Zonnequa Wind Farm grid connection solution[2]. The Strandveld Substation is located ~6km from the northern boundary of the Namas Wind Farm project site. This option is only viable should the Zonnequa Wind Farm be developed.

[2] The grid connection infrastructure for the Zonnequa Wind Farm is being assessed as part of a separate Basic Assessment Process.

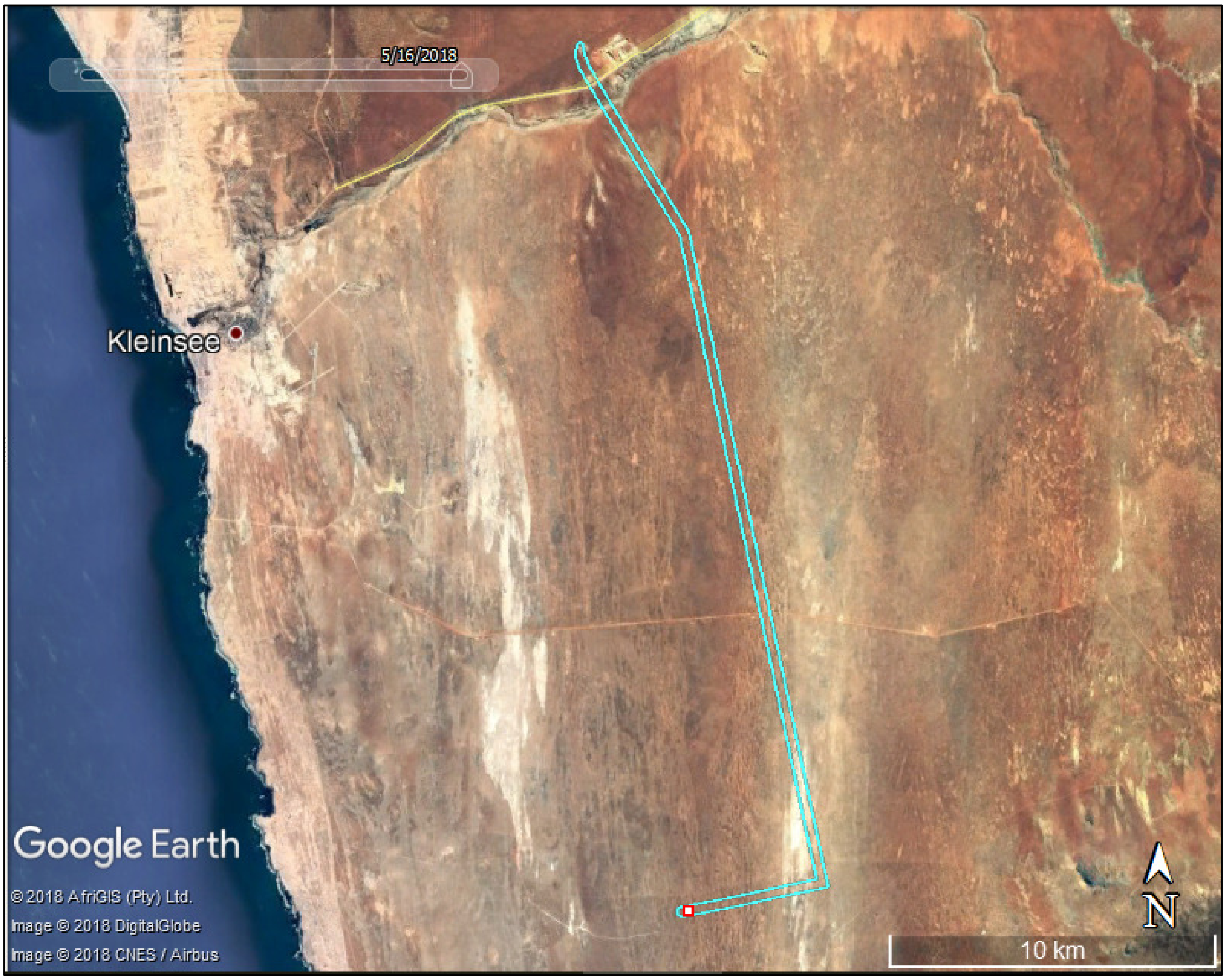

Figure 2: *Aerial view of the study area showing the 300m corridor footprint (turquoise) and the collector substation location (red square) located within the corridor.*

1.1.1. Aspects of the project relevant to the heritage study

All aspects of the proposed development are relevant since excavations for foundations and/or services may impact on archaeological and/or palaeontological remains, while all above-ground aspects create potential visual (contextual) impacts to the cultural landscape and any significant heritage sites that might be visually sensitive.

1.2. Terms of reference

ASHA Consulting was appointed to assess the potential impacts to heritage resources and produce a Heritage Impact Assessment (HIA). The assessment should comply with the relevant legislation and must be based on a field survey and desktop research. Following S.38(3) of the National Heritage Resources Act (No. 25 of 1999), all relevant aspects of heritage are to be considered in the assessment.

1.3. Scope and purpose of the report

An HIA is a means of identifying any significant heritage resources before development begins so that these can be managed in such a way as to allow the development to proceed (if appropriate) without undue impacts to the fragile heritage of South Africa. This HIA report aims to fulfil the requirements of the heritage authorities such that a comment can be issued by them for consideration by the National Department of Environmental Affairs (DEA) who will review the Basic Assessment Report[3] (BAR) and grant or refuse authorisation. The HIA report will outline any management and/or mitigation requirements that will need to be complied with from a heritage point of view and that should be included in the Environmental Management Programme (EMPr) and the conditions of authorisation should this be granted.

1.4. The author

Dr Jayson Orton has an MA (UCT, 2004) and a D.Phil (Oxford, UK, 2013), both in archaeology, and has been conducting HIAs and archaeological specialist studies in South Africa (primarily in the Western Cape and Northern Cape provinces) since 2004 (please see curriculum vitae included as Appendix 1). He has also conducted research on aspects of the Later Stone Age in these provinces and published widely on the topic. He is an accredited heritage practitioner with the Association of Professional Heritage Practitioners (APHP; Member #43) and also holds archaeological accreditation with the Association of Southern African Professional Archaeologists (ASAPA) CRM section (Member #233) as follows:

- Principal Investigator: Stone Age, Shell Middens & Grave Relocation; and
- Field Director: Colonial Period & Rock Art.

1.5. Declaration of independence

ASHA Consulting (Pty) Ltd and its consultants have no financial or other interest in the proposed development and will derive no benefits other than fair remuneration for consulting services provided.

2. HERITAGE LEGISLATION

The National Heritage Resources Act (NHRA) No. 25 of 1999 protects a variety of heritage resources as follows:

- Section 34: structures older than 60 years;
- Section 35: palaeontological, prehistoric and historical material (including ruins) more than 100 years old;
- Section 36: graves and human remains older than 60 years and located outside of a formal cemetery administered by a local authority; and
- Section 37: public monuments and memorials.

[3] Note that the project falls with a Renewable Energy Development Zone (REDZ) and as such is to be assessed via a Basic Assessment and not a full Environmental Impact Assessment.

Following Section 2, the definitions applicable to the above protections are as follows:

- Structures: "any building, works, device or other facility made by people and which is fixed to land, and includes any fixtures, fittings and equipment associated therewith";
- Palaeontological material: "any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or trace";
- Archaeological material: a) "material remains resulting from human activity which are in a state of disuse and are in or on land and which are older than 100 years, including artefacts, human and hominid remains and artificial features and structures"; b) "rock art, being any form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was executed by human agency and which is older than 100 years, including any area within 10m of such representation"; c) "wrecks, being any vessel or aircraft, or any part thereof, which was wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the maritime culture zone of the Republic, as defined respectively in sections 3, 4 and 6 of the Maritime Zones Act, 1994 (Act No. 15 of 1994), and any cargo, debris or artefacts found or associated therewith, which is older than 60 years or which SAHRA considers to be worthy of conservation"; and d) "features, structures and artefacts associated with military history which are older than 75 years and the sites on which they are found";
- Grave: "means a place of interment and includes the contents, headstone or other marker of such a place and any other structure on or associated with such place"; and
- Public monuments and memorials: "all monuments and memorials a) "erected on land belonging to any branch of central, provincial or local government, or on land belonging to any organisation funded by or established in terms of the legislation of such a branch of government"; or b) "which were paid for by public subscription, government funds, or a public-spirited or military organisation, and are on land belonging to any private individual."

While landscapes with cultural significance do not have a dedicated Section in the NHRA, they are protected under the definition of the National Estate (Section 3). Section 3(2)(c) and (d) list "historical settlements and townscapes" and "landscapes and natural features of cultural significance" as part of the National Estate. Furthermore, Section 3(3) describes the reasons a place or object may have cultural heritage value; some of these speak directly to cultural landscapes.

Section 38(8) of the NHRA states that if an impact assessment is required under any legislation other than the NHRA then it must include a heritage component that satisfies the requirements of S.38(3). Furthermore, the comments of the relevant heritage authority must be sought and considered by the competent authority prior to the issuing of a decision. Under the National Environmental Management Act (No. 107 of 1998; NEMA), as amended, the project would require an Environmental Impact Assessment (EIA) but because it falls within a Renewable Energy Development Zone (REDZ) a Basic Assessment process may be followed. The present report provides the heritage component. Ngwao-Boswa Ya Kapa Bokoni (Heritage Northern Cape; for built environment and cultural landscapes) and the South African Heritage Resources Agency (SAHRA for archaeology and palaeontology) are required to provide comment on the proposed project in order to facilitate final decision making by the National Department of Environmental Affairs.

3. METHODS

3.1. Literature survey and information sources

A survey of available literature was carried out to assess the general heritage context into which the development would be set. This literature included published material, unpublished commercial reports and online material, including reports sourced from the South African Heritage Resources Information System (SAHRIS). The 1:50 000 map and historical aerial images were sourced from the Chief Directorate: National Geo-Spatial Information.

3.2. Field survey

The southern and northern[4] part of the 300m corridor were subjected to foot surveys from 26th February to 2nd March 2018. The survey was in late summer, although in this dry climate seasonality has no effect on the degree of visibility of archaeological remains on the ground. During the survey, the positions of finds were recorded on a hand-held Global Positioning System (GPS) receiver set to the WGS84 datum. Photographs were taken at times in order to capture representative samples of both the affected heritage and the landscape setting of the proposed development.

The naming of archaeological sites follows a convention long in use in Namaqualand and has initial letters for the farm name, a year of discovery and a site number for that year. Site names were only allocated when anthropogenic influence was evident (i.e. cultural material was seen) or, in the case of only stone artefacts, when there were five or more artefacts that were fairly clearly associated. The farm acronyms for those farms on which sites were found are as follows:

- RV: Rooivlei 327;
- ZK: Zonnekwa 326;
- ZN: Zonnekwa 328;
- MV: Mannel's Vlei 321; and
- DKG: Dikgat.

3.3. Specialist studies

A separate assessment of palaeontological heritage was commissioned. This was carried out as a desktop study by John Pether. This study is referenced in the present HIA and included as Appendix 2 of this report.

3.4. Impact assessment

For consistency among specialist studies, the impact assessment was conducted through the application of a scale supplied by Savannah Environmental.

[4] But note that the survey of the northern section was just outside the corridor owing to a change made to the corridor after the ground survey.

3.5. Grading

S.7(1) of the NHRA provides for the grading of heritage resources into those of National (Grade I), Provincial (Grade II) and Local (Grade III) significance. Grading is intended to allow for the identification of the appropriate level of management for any given heritage resource. Grade I and II resources are intended to be managed by the national and provincial heritage resources authorities respectively, while Grade III resources would be managed by the relevant local planning authority. These bodies are responsible for grading, but anyone may make recommendations for grading.

It is intended under S.7(2) that the various provincial authorities formulate a system for the further detailed grading of heritage resources of local significance but this is generally yet to happen. SAHRA (2007) has formulated its own system[5] for use in provinces where it has commenting authority. In this system sites of high local significance are given Grade IIIA (with the implication that the site should be preserved in its entirety) and Grade IIIB (with the implication that part of the site could be mitigated and part preserved as appropriate) while sites of lesser significance are referred to as having 'General Protection' (GP) and rated GP A (high/medium significance, requires mitigation), GP B (medium significance, requires recording) or GP C (low significance, requires no further action).

3.6. Consultation

The NHRA requires consultation as part of an HIA but, since the present study falls within the context of a BAR which includes a public participation process (PPP), no dedicated consultation was undertaken as part of the HIA. Interested and affected parties would have the opportunity to provide comment on the heritage aspects of the project during the PPP of the BAR.

3.7. Assumptions and limitations

The field study was carried out at the surface only and hence any completely buried archaeological sites or palaeontological occurrences would not be readily located. Similarly, it is not always possible to determine the depth of archaeological material visible at the surface. One section of the
300m corridor was not accessible during the survey due to high electrified fencing but from aerial photography it seems to have fewer of the sorts of landforms that would have attracted precolonial occupation. This restriction will therefore not negatively affect the conclusions of this report. It is notable that the 300m corridor was adjusted towards the west after the survey so very little of the northern part was physically examined in the field. Although many visible locations that seemed as though they might yield archaeological sites were visited (and some of these lie within the current corridor), it is quite likely that further archaeological sites will be present in the corridors as assessed here. It is assumed, however, that they will be similar to those already on record and this allows for an accurate assessment of the potential impact significance.

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[5] The system is intended for use on archaeological and palaeontological sites only.

4. PHYSICAL ENVIRONMENTAL CONTEXT

4.1. Site context

The 300m corridor passes through sparsely developed farm land with occasional jeep tracks and farm fences. Its central section crosses the Kleinsee-Komaggas gravel road while in the north it crosses the Buffels River and the Kleinsee-Springbok gravel road. It then enters the existing Gromis Substation located ~1.0 km northwest of the Springbok road. Around the northern part of the corridor there has been some diamond mining in the past and the remnants of such activities are still visible in the form of mine dumps and disturbed areas to the north of the Springbok Road as well as 4 km northeast of the 300m corridor on the south side of the Buffels River. An existing power line runs along the Kleinsee-Komaggas road.

Although several other renewable energy facilities and power lines have been proposed in the area, none have yet been constructed which means that the area retains its rural context with mining along the river and also on and near the coastline further to the northwest. It is notable that a large power line extending from the Gromis Substation to the Juno Substation near Vredendal (known as the Juno Gromis 400kV power line) is scheduled to be built in the near future and that the presently proposed corridor runs immediately adjacent and parallel to this authorised power line.

4.2. Site description

In the south the 300m corridor largely traverses a belt of tall red dunes (Figure 3) and in the far north crosses an area where many open deflation hollows occur (Figure 4). Hereafter it crosses an area of exposed *heuweltjies*, passes over the Buffels River then runs a short distance up the slope to the existing Gromis Substation (although the substation is not visible, its access road can be seen in Figure 5). The vicinity of the Buffels River is the only place in the entire 300m corridor that rock outcrops occur but these are very low (Figure 5) with the exception of some bedrock in the river bed.

Figure 3: *View towards the northeast across the dune cordon in the southern part of the 300m corridor.*

Figure 4: *View across a deflation hollow with other similar hollows in the background marked by orange sandy patches on the landscape. This is at site MV2018/026 (waypoint 089).*

Figure 5: *View along the 300m corridor over the Buffels River valley towards the existing Gromis Substation (arrowed). An abandoned mining area lies to the right (east) of the Substation. A low bedrock exposure is visible in the foreground.*

An important component of Namaqualand is the presence of a hardened soil horizon – known as dorbank – below the cover sands. This dorbank is revealed in borrow pits which have been excavated into it and occasionally in other areas where erosion has removed the aeolian cover sands, such as on the southern bank of the Buffels River (Figure 6).

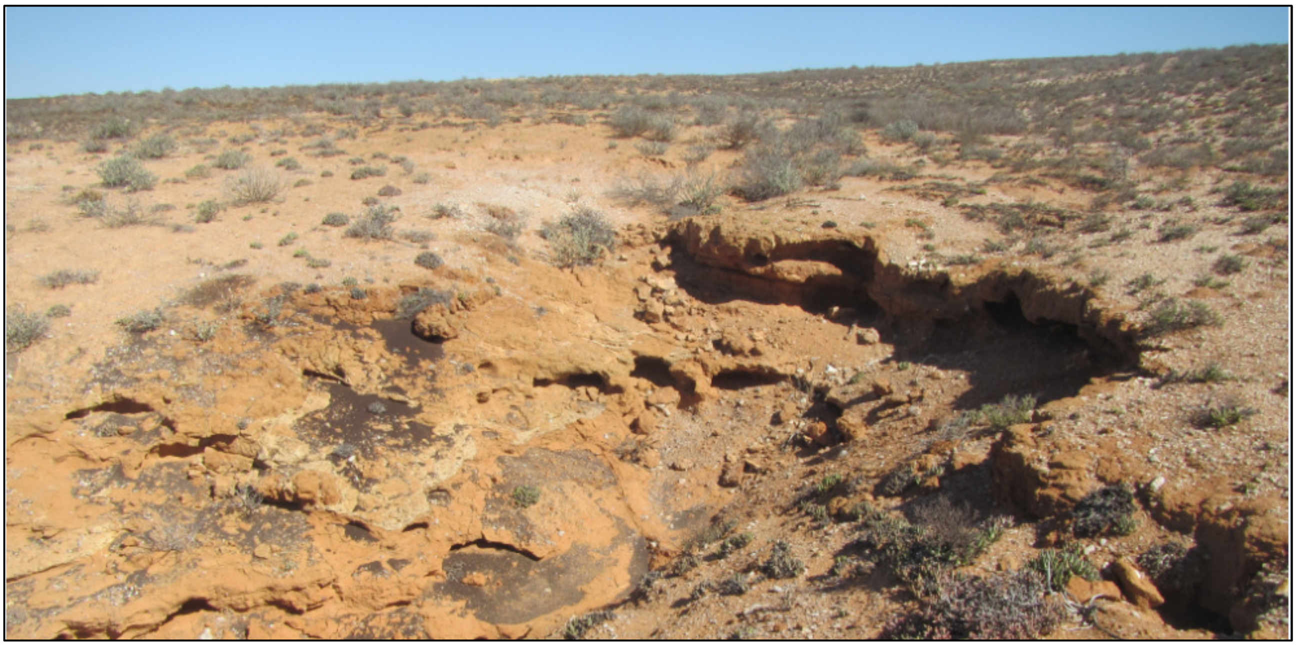

Figure 6: *View of an exposed area of Dorbank to the south of the Buffels River.*

5. ARCHAEOLOGICAL AND HISTORICAL CONTEXT

This section of the report contains the desktop study and establishes what is already known about the archaeological heritage in the vicinity of the 300m corridor. This will assist in the interpretation and understanding of the newly reported material.

5.1. Archaeological aspects

Early Stone Age (ESA) materials in Namaqualand have mostly been found fairly close to the coastline and are often found in the same contexts as Middle Stone Age (MSA) artefacts. Halkett (2002) reported a large scatter of ESA artefacts from Kleinsee, while Orton and Webley (2012b) found ESA and MSA artefacts associated with fossil bones on the high ground to the north of the Buffels River, northeast of Kleinsee. Much further south, in the Western Cape, Hart and Halkett (1994) excavated an ESA sample adjacent to a quarried silcrete outcrop, while not far away Orton (2017) found extensive scatters of ESA material – including abundant handaxes – at the interface of the dorbank and aeolian cover sands. Some 20 km north of Kleinsee, Orton and Halkett (2006) described an extensive silcrete outcrop that displayed evidence of quarrying. There were scatters of ESA and MSA artefacts located across the outcrop. Further inland, to the southeast of the present study area (i.e. the 300m corridor), Morris and Webley (2004) reported scatters of ESA artefacts, including handaxes, amongst sand dunes on the coastal plain and around pans.

Middle Stone Age (MSA) material is generally more commonly reported, but further inland tends to occur as isolated artefacts or as very ephemeral scatters. To the northwest of Komaggas, Dreyer (2002) reported MSA artefacts on quartzite and hornfels associated with river gravel about 1 km from the Buffels River. Van Pletzen-Vos and Rust (2011) found MSA quartz artefacts on the western and northern outskirts of Komaggas. In the Kamiesberg Mountains, Howieson's Poort-type implements belonging to the MSA were found in Keurbos Cave some 15km north-east of Garies (Webley 1992), while MSA implements were found in excavations at a small rock shelter called Wolfkraal close to Kharkams (Webley 1984). Near Garies in central Namaqualand, Webley and Halkett (2010) reported on a MSA factory site on Swartkop, an outcrop of dark, fine-grained rock which appears to have been targeted by prehistoric populations. Closer to the coast Orton and Halkett (2005) found some Howieson's Poort bifacial points associated with shell in a dunefield 22 km south of the present study area (i.e. 300m corridor), but the relationship between the shell and artefacts might be spurious. Halkett and Hart (1997) and Jerardino *et al.* (1992) reported scatters of MSA artefacts north of Kleinsee and at the Groen River Mouth respectively.

Later Stone Age (LSA) material is regularly found throughout Namaqualand. The coastal and near-coastal areas, however, have by far the greatest number of reported sites (Dewar 2008; Orton 2012). Many thousands of shell middens and scatters occur along the coast, some of them preserving rich assemblages of cultural materials and food remains. While these focus on the area within about 2 km to 3 km of the coast, shell scatters have been found along the Buffels River up to 10 km inland (Orton & Webley 2012b). Almost all sites are open sites with just one coastal rock shelter known to contain LSA deposits (Webley 1992. 2002). Inland the best sites tend to be rock shelters with the majority of other sites being relatively ephemeral open artefact scatters. Most work in the inland region has been done by Webley (1986, 1992, 2007) with a focus on rock shelters. Although not common, rock art has been recorded at various locations in the central part of Namaqualand (Orton 2013; Morris & Webley 2004). Orton (2013) ascribes the geometric rock art designs to Khoekhoe herders. Southeast of the present study area (i.e. 300m corridor), in the Namaqualand National Park, both representational and geometric rock art sites were recorded (Morris & Webley 2004).

The last 2000 years are especially important for archaeological research in Namaqualand. Archaeological sites from this period with pottery are reported from a number of sites and are believed to be associated with the introduction of herding and/or pastoralism to the region some 2000 years ago. The region is known to be important in terms of the beginnings of herding, but the details of how it happened are still highly contested (Orton 2015). The archaeology supports the historic information that pastoralist groups (the ancestors of the Little Namaqua Khoekhoen) were occupying this area at and before the time of colonial contact.

Two other surveys have been conducted in close proximity to the present study area (i.e. 300m corridor). Magoma's (2016) linear survey through its eastern part yielded only isolated artefacts, while immediately northwest of the present study area Orton and Webley (2012a) found large numbers of LSA sites spread across the landscape. Slightly further but on the adjoining farms to the east and southeast, Orton (2018) found a number of LSA sites on the ridges of the inselberg formed by Brandberg, Byneskop and Graafwater se Kop. The sites consisted only of stone artefacts. Figure 7 shows the distribution of archaeological sites known to the author in the vicinity of the 300m corridor.

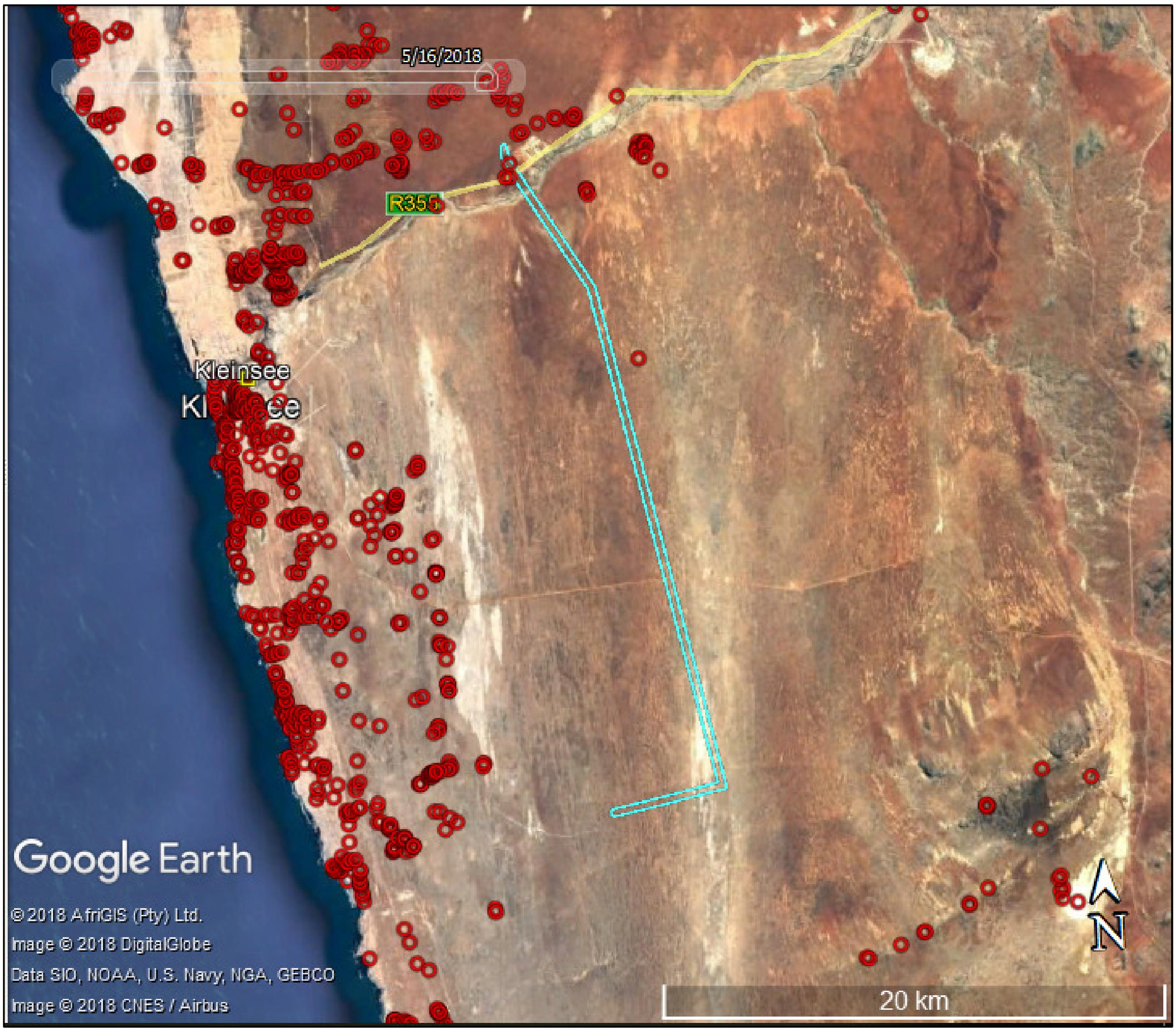

Figure 7: *Map showing the distribution of archaeological sites known to the author prior to commencement of the present study. Study area (i.e. 300m wide corridor) in turquoise.*

5.2. Historical aspects

Namaqualand is quite remote and relatively unproductive from an agricultural point of view. As a result, it does not have as deep a history as many other parts of South Africa. Although the little settlement of Gootmis just inland of Kleinsee and the mission station at Komaggas dates back into the 19th century, the larger towns of Kleinsee and Koingnaas – both originally developed as 'company towns' – relate to 20th century diamond mining.

Grootmis was historically important because it had water. An annotation on a 1907 British Military map states that Grootmis had an unlimited water supply (Source: Pietermaritzburg Archives). The very large number of shell scatters found in the area by Orton and Webley (2012b) suggests that this water source had been available for some time. It probably stopped yielding water when De Beers dammed the river and commenced with the abstraction of water.

Komaggas (Camaggas) is first mentioned by Gordon in 1779. Komaggas (the farm is spelled Kamaggas, a form that also appears on some early maps) received a Certificate of Occupation on 9 November 1843, granting the Cloete family the right of occupation on the land.

There are various oral accounts of the relationship between Ryk Jasper Cloete and the Nama kaptein kXurib who used the Komaggas Fountain as his main water source. Bregman (2010) suggests that he acquired the land through his marriage to the kaptein's daughter. Jasper Cloete utilised land up to the Orange River to graze his stock. A mission station of the London Missionary Society (LMS) was set up at Komaggas in 1829 and the farm was surveyed in 1831. It became a station of the Rhenish Missionary Society in 1843 and then the N.G. Church from 1936 (Raper n.d.).

Bregman (2010) provides a list of the farms surrounding and in the vicinity of Komaggas, including the date that they were first registered. Farms to the west of Komaggas were granted to colonists under quitrent title only after 1855. Mining companies were seeking land in the area because of the commencement of copper mining. Closer to the coast, the dry plains between the Swartlintjies and Buffels Rivers were left open as Crown Land – this is the zone in which the present study area (i.e. 300m corridor) lies. Despite the increasing private ownership of farms in the area, herders from Komaggas were still able to access grazing lands outside of the reserve because the farms were not completely fenced and access was gained at certain places. However, they had no formal title to the land. In 1925 diamonds were discovered on the farm Oubeep, south of Port Nolloth, and in 1926 at Kleyne Zee, both by Jack Carstens. Mining commenced at the latter in 1927 and the town of Kleinsee was soon established (Rebelo 2003). Much of the coastline was then bought up for diamond mining and access for grazing was closed.

6. FINDINGS OF THE HERITAGE STUDY

All finds from the field survey are listed and described in Table 2.

Table 2: *List of heritage resources recorded during the survey. The number of hours in the significance column indicates the estimated amount of time that might be required for mitigation if a site cannot be avoided and mitigation is required.*

Waypoint	Site name	Co-ordinates	Description	Significance Mitigation
043	ZN2018/007	S29 50 17.1 E17 13 26.4	Ephemeral artefact scatter located just to the east of the sandy summit of a hill. Just 6 quartz artefacts. Just outside the 300m corridor.	Low
046	ZN2018/010	S29 50 07.1 E17 14 03.1	Light scatter of ostrich eggshell (9 pieces seen) that includes a cone flake showing that an egg was broken open from the outside.	Very low
057	---	S29 48 57.5 E17 15 16.9	A shallow borrow pit revealing background scatter quartz (9 seen) and CCS (2 seen) artefacts associated with the dorbank. Also some ostrich eggshell.	Very low
059	---	S29 36 07.2 E17 10 58.2	Background scatter located in an area of exposed hardpan off of which the sand has been removed. The artefacts are of quartz, quartzite, and silcrete and there are many quartzite cobbles. There are some clear hammer stones and one upper grindstone that still bears a 'greasy stain' is presumed to be LSA. The majority of the material is likely MSA or ESA and a single ESA handaxe made from quartzite was seen.	Low

060	DKG2018/001	S29 36 25.4 E17 11 06.8	Ephemeral scatter of *C. granatina* shell and one piece of ostrich eggshell.	Low
061	---	S29 36 37.9 E17 11 16.1	Widespread background scatter of quartz artefacts in an area where there are bedrock patches exposed on the north bank of the Buffels River.	Very low
062	---	S29 36 53.8 E17 11 30.1	Widespread background scatter of quartz artefacts in an area where there are bedrock patches exposed on the south bank of the Buffels River.	Very low
063	---	S29 36 58.9 E17 11 31.1	Widespread background scatter of quartz artefacts on red sand with many larger grains. This phenomenon is very widespread and the four recorded points cover most of the north-south range.	Very low
063B		S29 37 09.3 E17 11 37.7		
063C		S29 37 22.1 E17 11 47.4		
063D		S29 37 40.9 E17 11 59.5		
064	MV2018/001	S29 37 16.1 E17 11 42.1	Ephemeral shell scatter of *C. granatina* and *S. granularis* with some ostrich eggshell. Due to the quartz background scatter it is hard to know if there are stone artefacts directly associated with the shell or not.	Low
065	MV2018/002	S29 37 25.0 E17 11 48.2	Ephemeral scatter of *C. granatina* and *S. granularis* located on a slight rise. Due to the quartz background scatter it is hard to know if there are stone artefacts directly associated with the shell or not.	Low
066	MV2018/003	S29 37 54.7 E17 12 09.5	An outcrop of quartz that has been hammered and flaked.	Low
067	MV2018/004	S29 38 02.9 E17 12 14.8	An outcrop of quartz that has been hammered and flaked. It includes one loose boulder which has been rolled around and flaked on various sides like a large irregular core.	Low
068	MV2018/005	S29 38 15.8 E17 12 25.4	A light scatter of informal quartz artefacts located in the southern end of a deflation hollow. It also has ostrich eggshell fragments, a quartzite upper grindstone and a quartzite cobble. Patch B is a group of artefacts and quartz pieces on an exposed area of hardpan in the northern end of the same deflation hollow. They are very weathered and only some are artefacts.	Low **2 hours** (Patch A only)
068B		S29 38 13.8 E17 12 26.3		
069	MV2018/006	S29 38 44.6 E17 12 54.0	A light scatter of informal quartz artefacts located in a large deflation hollow. It also has occasional ostrich eggshell fragments. An isolated upper grindstone was found in the north-western part of the deflation hollow. It fits well in the hand and the wear pattern suggests use with the right hand.	Low **2 hours** (Patch A only)
070A	MV2018/007	S29 38 36.5 E17 12 59.8	Patch A: A light scatter of informal quartz artefacts located in the southern end of a deflation hollow. There is also a quartzite hammer stone and a quartzite hammer stone/upper grindstone. Patch B: A light scatter of informal quartz artefacts located in the northern end of the same deflation hollow. It also includes a CCS edge-damaged flake and a quartzite hammer stone that was also flaked as an irregular core.	Low **2 hours**
070B		S29 38 34.0 E17 12 59.3		
071	MV2018/008	S29 38 25.1 E17 12 58.6	A small, discrete scatter of informal quartz and quartzite artefacts in the centre of a deflation hollow. The scatter is about 5 m by 4 m and the rest of the hollow is essentially sterile. There is also a CCS notched piece on the scatter.	Low-medium **2 hours**
072	MV2018/009	S29 38 25.0 E17 13 05.1	An ephemeral scatter of informal quartz artefacts throughout a deflation hollow but with a slight concentration at the waypoint.	Low **2 hours**
073	MV2018/010	S29 38 31.0 E17 13 12.4	An ephemeral scatter of informal quartz artefacts throughout a deflation hollow but with a concentration of artefacts and quartz blocks at the waypoint.	Low **2 hours**
074A	MV2018/011	S29 38 34.9 E17 13 11.8	Patch A: A dense ostrich eggshell scatter with many burnt fragments located in the northern end of a deflation hollow.	Medium **4 hours**

074B		S29 38 36.6 E17 13 11.6	There are quartzite flakes but none in quartz, and a quartzite hammer stone. There are also many small rusted metal fragments and, a few meters away, a small historical medicine bottle. Patch B: A light scatter of informal quartz artefacts located in the southern end of the same deflation hollow. There is also some ostrich eggshell, a quartzite lower grindstone, a quartzite hammer stone/upper grindstone, two quartzite hammer stones and two CCS flakes. There is a dense concentration just east of the waypoint. Patch C: A dense scatter of ostrich eggshell was found high on the side of the deflation hollow in the southeast. It also has occasional quartz and CCS artefacts associated with it.	
074C		S29 38 37.1 E17 13 12.1		
075	MV2018/012	S29 39 25.8 E17 12 53.9	An ephemeral scatter of informal quartz artefacts located in a small deflation. There were only about 10 quartz artefacts along with one in CCS and one ostrich eggshell fragment.	Low
076	MV2018/013	S29 39 32.2 E17 13 03.9	A widespread but light scatter of informal quartz artefacts located in the southern end of a deflation hollow. The scatter extends up the sandy slope at the southern end of the deflation which suggest it to be very recent. There is also a lower grindstone (found right way up) in the western part of the deflation hollow.	Low **2 hours**
077A	MV2018/014	S29 39 39.9 E17 12 59.8	Patch A: A small, light scatter of informal quartz artefacts located in the northern end of a large deflation hollow. There are only about 30 artefacts visible.	Low
077B		S29 39 41.0 E17 12 59.9	Patch B: A second similar scatter but with only about 10 artefacts visible but these are all quite large and there is some accumulated sand at this point. Smaller artefacts may thus be buried.	
078	MV2018/015	S29 39 47.7 E17 13 00.2	A light scatter of ostrich eggshell fragments and some informal quartz artefacts in the northern end of a deflation hollow.	Low
079	MV2018/016	S29 40 02.0 E17 13 09.6	A light scatter of informal quartz artefacts throughout a small deflation hollow. The scatter is most dense in the centre of the deflation hollow. Also 2 CCS flakes, a quartzite manuport and a quartzite probable grindstone fragment.	Low **2 hours**
080A	MV2018/017	S29 40 18.0 E17 13 22.5	Patch A: An ephemeral scatter of informal quartz artefacts throughout a deflation hollow but with a dense patch of ostrich eggshell in the centre of the hollow. There are also two brown transfer-printed plate rim fragments (they refit together) with the ostrich eggshell. Patch B: A light scatter of informal quartz artefacts and small rusted metal fragments in the southern end of the same deflation hollow. They are quite high up the southern end of the hollow but located on a flat area. There are also two CCS flakes, a *C. granatina* fragment and two left crayfish mandibles.	Low **2 hours**
080B		S29 40 20.6 E17 13 22.6		
081	MV2018/018	S29 40 09.2 E17 13 00.0	A small deflation hollow with only one quartz artefact, two CCS artefacts and one pot rim (plain rounded rim).	Very low
082	MV2018/019	S29 40 09.8 E17 12 51.3	A light to moderate scatter of informal quartz artefacts in a small deflation hollow. There are also some CCS and quartzite flakes, a quartzite upper grindstone, and a small quartzite sausage-shaped hammer stone.	Low **2 hours**
083	MV2018/020	S29 40 06.5 E17 12 51.0	A very ephemeral scatter of informal quartz artefacts in a fairly large deflation hollow. Also one ostrich eggshell fragment seen.	Low
084	MV2018/021	S29 39 58.8 E17 12 52.0	A scatter of ostrich eggshell in the southern end of a large deflation hollow. There are also some quartz and CCS artefacts as well as a quartzite hammer stone/upper grindstone fragment. There was also a fragment of lead and a single ostrich eggshell fragment in the northern end of the same deflation hollow.	Low
085	MV2018/022	S29 39 49.9 E17 12 55.3	An ephemeral scatter of informal quartz artefacts in a deflation hollow.	Low

086	MV2018/023	S29 39 43.5 E17 12 55.2	An ephemeral scatter of informal quartz artefacts in a large deflation hollow.	Low
087	MV2018/024	S29 39 31.6 E17 12 56.5	A light scatter of quartz artefacts in a tiny deflation hollow. The quartz looks generally of better quality and is not yellowed from exposure to the red sand. Unlike the other sites in this area, all pieces appear to be flaked artefacts. There is a large quartz cobble core.	Low **2 hours**
088	MV2018/025	S29 38 25.3 E17 12 22.4	A slight concentration of small LSA quartz artefacts among the general background scatter of older artefacts.	Very low
089	MV2018/026	S29 38 24.5 E17 12 18.7	A moderate density scatter of informal quartz artefacts in a deflation hollow. Also some flaked artefacts in quartzite, CCS and 'other'. There are two cobbles with light evidence of grinding and anvil use. The quartz artefacts look quite fresh but the usual selection of manuports and unmodified quartz fragments shows affinity with the informal quartz assemblages.	Low **4 hours**
090	MV2018/027	S29 38 26.2 E17 12 17.4	A light scatter of informal quartz artefacts in a deflation hollow. Also some CCS and a small quartz pebble hammer stone.	Low **2 hours**
091	MV2018/028	S29 38 27.4 E17 12 16.2	A dense scatter of informal quartz artefacts in a deflation hollow. There are also some CCS flakes, a CCS scraper fragment, a few quartzite hammer stones, a quartzite hammer stone/upper grindstone, and some glass. There are many ostrich eggshell fragments in the southern part of the deflation hollow.	Medium **8 hours**
092	MV2018/029	S29 38 28.5 E17 12 13.2	An ephemeral scatter of informal quartz artefacts in a shallow deflation hollow.	Low
093A	MV2018/030	S29 38 21.1 E17 12 19.9	Patch A: An ephemeral scatter of informal quartz artefacts in the southern end of a large deflation hollow. Also a quartzite hammer stone fragment. Patch B: A small patch of light scatter in the western side of the same deflation hollow. Also has a quartzite hammer stone and a small 'other' pebble. Patch C: An extensive but light scatter of informal quartz artefacts in the eastern side of the same deflation hollow. There are also several manuports and a quartzite hammer stone/upper grindstone. Patch D: A small but moderate density scatter of informal quartz artefacts in the northern end of the same deflation hollow. There are also two quartzite hammer stones, a quartzite hammer stone/upper grindstone and a large quartz core made on a block of quartz. Patch E: A light scatter of informal quartz artefacts in the central part of the same deflation hollow. There are no other associated finds here.	Medium **8 hours**
093B		S29 38 19.9 E17 12 20.1		
093C		S29 38 20.3 E17 12 21.1		
093D		S29 38 19.2 E17 12 20.7		
093E		S29 38 19.9 E17 12 20.6		
094	MV2018/031	S29 38 19.3 E17 12 22.3	An ephemeral scatter of informal quartz artefacts in a small deflation hollow.	Low
095	MV2018/032	S29 38 17.4 E17 12 23.5	An ephemeral scatter of informal quartz artefacts in a shallow deflation hollow. There are also several unmodified quartz rocks (manuports).	Low
096	MV2018/033	S29 37 25.6 E17 11 46.9	An ephemeral scatter of *C. granatina* and *S. granularis* with some ostrich eggshell fragments on the slope overlooking the Buffels River to the north. Due to the quartz background scatter it is hard to know if there are stone artefacts directly associated with the shell or not.	Low
097	MV2018/034	S29 37 18.2 E17 11 42.4	A light but quite large scatter of *C. granatina* and *S. granularis* on the slope overlooking the Buffels River to the north. Due to the quartz background scatter it is hard to know if there are stone artefacts directly associated with the shell or not. There is also some pottery (9 sherds seen including 1 rim), a CCS flake and quartzite upper grindstone.	Low-medium **4 hours**
098	MV2018/035	S29 37 17.5 E17 11 42.0	A light scatter of *C. granatina* and *S. granularis* with some ostrich eggshell fragments on the slope overlooking the Buffels River to the north. Due to the quartz background	Low-medium **2 hours**

			scatter, it is hard to know if there are stone artefacts directly associated with the shell or not. There are also two quartzite hammer stones.	
099	DKG2018/002	S29 36 48.5 E17 11 21.2	An ephemeral scatter of quartz artefacts with one piece of *S. granularis* and one of *C. granatina* on the slope overlooking the Buffels River to the south.	Low
100	---	S29 36 27.4 E17 11 05.6	An area of exposed hardpan with many quartz artefacts exposed. Also a few in silcrete and quartzite.	Very low.
103	ZK2018/003	S29 46 50.5 E17 14 50.4	An ostrich eggshell flask cache with two flasks located immediately north of the summit of a low hill. One egg is whole and the other broken. Only one mouth fragment was seen but overall there is well less eggshell than would be needed for a whole shell so there must have not been more than two shells. The whole shell's mouth is 14 x 18 mm and is quite irregular. The mouth fragment is similarly irregular.	Low-medium **1 hour**
109	---	S29 48 41.9 E17 14 52.9	Small family graveyard located to the east of the waypoint and with a single grave dating to 2008 (not visited). Just outside the 300m corridor.	---
110	ZK2018/009	S29 46 04.4 E17 14 36.9	A light artefact scatter in a deflated area on a sandy hilltop on the eastern edge of the large dune cordon overlooking the plains below. It has quartz (50+ seen) and CCS (1 notched flake seen) artefacts as well as a quartzite hammer stone/anvil/irregular core, ostrich eggshell fragments (10+ seen), some burnt bones fragments, a rim potsherd, fragments of a leather shoe, two modern clear glass bottles (one of them broken). The pot rim had either a flared or a vertical orientation and its form was tapered. The sherd was very thin. A second deflation hollow just to the east had an ephemeral scatter of quartz and quartzite with one *S. argenvillei* fragment and a piece of green glass.	Low-medium **2 hours**
112	ZK2018/011	S29 45 37.1 E17 14 28.5	A light scatter of ostrich eggshell fragments (11 seen) on a sandy hilltop. Although no artefacts were seen, the scatter must be anthropogenic.	Very low

6.1. Palaeontology

This summary is derived from Pether (2018) (Appendix 2). The affected surficial formations include early to mid-Holocene dunes of the Hardevlei Formation and earlier late Quaternary coversands of the Koekenaap Formation. Beneath these unconsolidated sands are compact, pedogenically-altered aeolianites termed "Dorbank Units" which are fossil dune plumes of later mid-Quaternary age. An older dorbank dune plume underlies the eastern part of the broader study area (east of the 300m corridor), while a later dorbank dune plume underlies the western part. Between these dune plume ridges is a non-depositional area which is closely underlain by pale pedocrete which is likely to have formed in early mid-Quaternary aeolianites equivalent to the Olifantsrivier Formation. The south-eastern section of the 300m corridor overlies this area.

The primary palaeontological concern is the fossil bones that are sparsely distributed in these aeolian deposits. Although sparse in both the aeolian Dorbank Units and the overlying coversands and dunes, they are of high scientific significance and important for palaeoclimatic, palaeobiological and biostratigraphic studies. The fossil material in these deposits is a sample of the middle and late Quaternary fauna of the Namaqualand coast.

6.2. Archaeology

In the south the 300m corridor begins on a belt of red sand dunes with many archaeological sites in them. It was noticeable that marine shell was largely absent, with ostrich eggshell fragments and stone artefacts dominating the scatters. The sites tended to be located on dune tops with the artefacts visible in deflated areas. These areas varied from lightly deflated and slightly less vegetated than the surrounding areas to proper deflation hollows, although the latter were by far in the minority and tended to be quite small compared to the deflation hollows located further north. These location types are shown in Figures 3 and 4. Only one small scatter of ostrich eggshell fragments with a cone flake demonstrating that the egg was broken from the outside was found within the southern part of the 300m corridor (waypoint 046). A number of other more important sites were found nearby within the associated Namas Wind Farm footprint but these will be reported and considered elsewhere.

Inland of this dune belt is an area of low-lying flat terrain characterised by pale sand. Although only a small section of this area was surveyed where it is traversed by the 300m corridor, work on the neighbouring Zonnequa Wind Farm site shows that this band is generally devoid of archaeological sites, even in places where low sand hills occur. Two occurrences were recorded in this zone, but both outside of the 300m corridor. One was of some background scatter artefacts in quartz and CCS and some ostrich eggshell fragments at an area where the cover sands had been removed (waypoint 057). The second, ZK2018/003 (waypoint 103), was on a low sand hill at the eastern edge of the flat plain and about 200 m east of the 300m corridor. It consisted of a small cache of two ostrich eggshells, one of them whole and one broken (Figure 8). The flask mouths were not as smoothly rounded as is normally expected (Figure 9).

Figure 8: *View of the ostrich eggshell cache as it was found.*

Figure 9: *The mouth of the whole eggshell and the fragment of a second mouth. Scale in 5 mm intervals.*

At the north end of the 300m corridor there is a red dunefield with many large deflation hollows. These hollows also contained many artefact scatters but again with very dense sites generally rare. The finds in these hollows included scatters of flaked artefacts, largely in quartz but with other materials also present, occasional grindstones and hammer stones, some pottery, and some historical glass and ceramics. Retouched tools were rare and the nature of the assemblages suggest that all or most were from the late Holocene. Whether the historical material is overprinted or related to the LSA material remains unknown. Figure 4 shows an example of one of these deflation hollows, while Figures 10 to 15 show a selection of items found at these sites.

Figure 10: *Two crayfish mandibles from MV2018/017 (waypoint 080B). Scale in cm.*

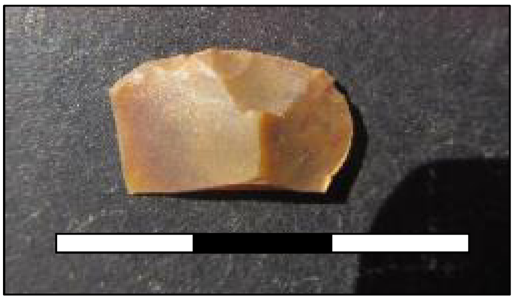

Figure 11: *A scraper fragment from MV2018/028 (waypoint 091). Scale in cm.*

Figure 12: *CCS and quartz artefacts from MV2018/018 (waypoint 081). Scale in cm.*

Figure 13: *Two large quartzite cores from MV2018/026 (waypoint 089). Scale in cm.*

Figure 14: *Two refitting plate fragments from MV2018/017 (waypoint 080A). Scale in cm.*

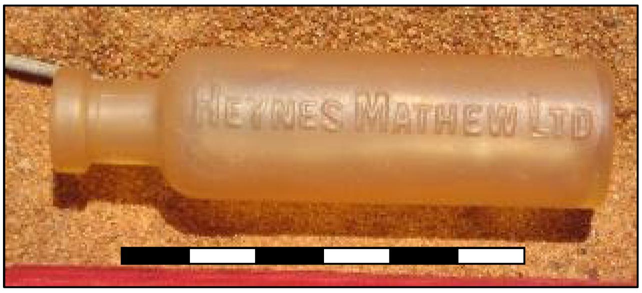

Figure 15: *Small medicine bottle from MV2018/011 (waypoint 024A). Scale in cm.*

In the far north, on either side of the Buffels River, there were places where the dorbank was exposed at the surface. In these areas MSA and ESA artefacts were seen. An example of an artefact stuck into the dorbank was noted to the south of the river (Figure 16), while to the north an area stripped of topsoil during mining activities displays an extensive scatter of Pleistocene-aged material, including handaxes (Figures 17 to 19). Within a few hundred metres on either side of the Buffels River there were a few light shell scatters. It was not possible to tell whether there were stone artefacts associated with them because of both the natural quartz gravel and the low density background scatter of quartz artefacts present. Figure 19 shows an example of one such scatter which also had pottery on it (MV2018/034; waypoint 97). Two small quartz outcrops displaying flaking were also noted to the south of the river.

Figure 16: *A large flake trapped in the dorbank to the south of the Buffels River. Scale in cm.*

Figure 17: *The dorbank surface at waypoint 059 with artefacts scattered over it.*

Figure 18: *Selection of stone artefacts and cobbles from the surface of the dorbank at waypoint 059. Scale in cm.*

Figure 19: *Three views of a small handaxe with basal cortex preserved (arrowed in right hand image) from waypoint 059. Scale in cm.*

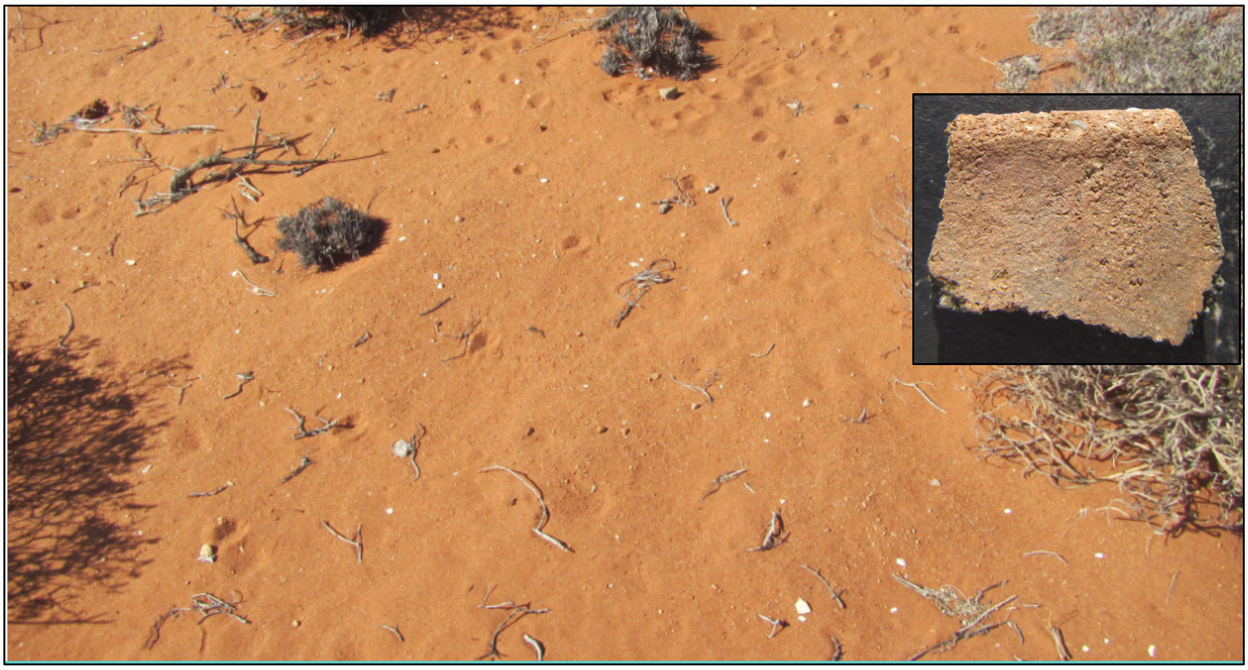

Figure 20: *The shell scatter at MV2018/034 (waypoint 97) with the inset showing a rim potsherd (rim length = 23 mm).*

6.3. Graves

No precolonial graves were discovered during the survey. No historical graves or graveyards were present. The graveyard on Zonnekwa 326 contains a single grave dated 2008 (waypoint 109). It is quite likely that unmarked precolonial graves will be present in the sand dunes but their locations cannot be predicted and if found they have to be dealt with on a case by case basis.

6.4. Built environment

No buildings will be directly impacted by the proposed project. Only one farm complex, that on Zonnekwa 326, lies close to but outside of the 300m corridor (the nearest structures are about 100 m west of the edge of the 300m corridor). Although not examined in detail on site, it is evident from the 1942 aerial photograph that a complex was present but was very much smaller than that of today (Figure 21). The majority of structures are clearly relatively modern (Figures 22 & 23).

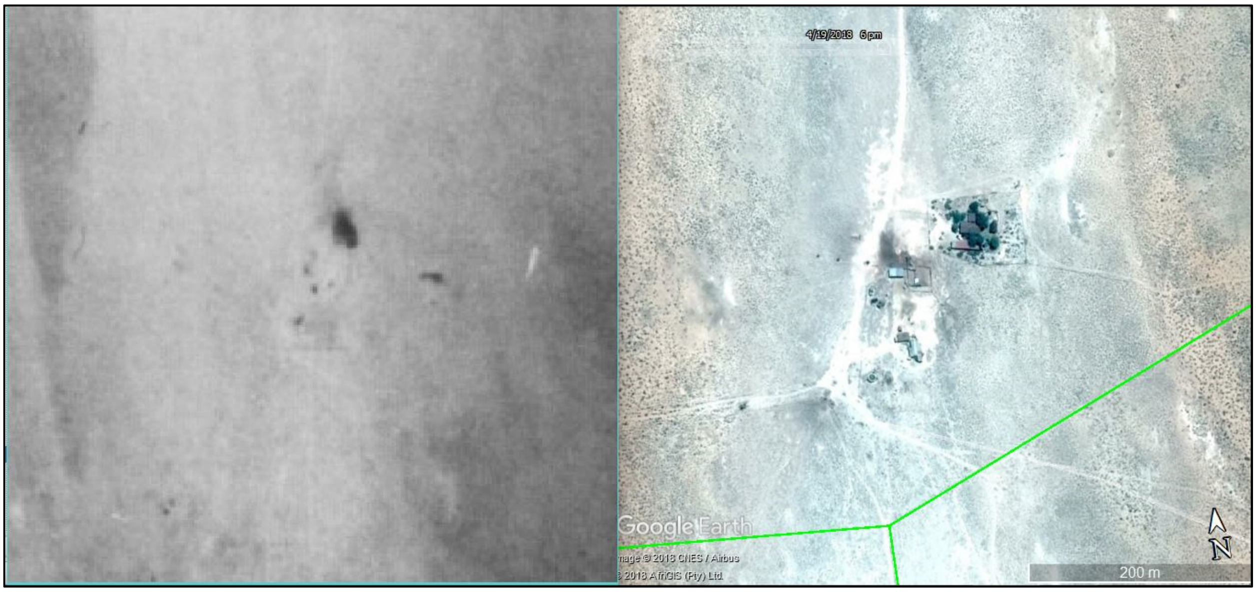

Figure 21: *Aerial views of the Zonnekwa 326 farm complex from 1942 (Source: Chief Directorate: National Geo-Spatial Information. Website: www.ngi.gov.za) and 2004 (Source: Google Earth) showing the complex to be much smaller in 1942*

Figure 22: *View of the main farm house at Zonnekwa 326 as seen from the south.*

Figure 23: *View of the outbuildings at Zonnekwa 326 as seen from the southeast. The main structure here may be the oldest in the complex.*

6.5. Cultural landscape

The 300m corridor is situated in a remote location and, being only very minimally developed, is largely considered a natural landscape rather than a rural one. The main exception, of course, is the mining landscape located at the northern end of the 300m corridor where the human imprint is far greater. Natural heritage also requires consideration because of the visual amenity provided by aesthetically pleasing landscapes. Aside from rare farm buildings, the only other anthropogenic features on the landscape are farm tracks/roads and fences, along with occasional borrow pits alongside the larger gravel roads. The landscape conveys a sense of remoteness and inhospitability that is a result of the very frequent strong winds, the low scrubby vegetation and seemingly endless sand flats and dunes. Importantly, it is a fairly flat landscape with the tallest anthropogenic features being wind pumps – aside from the mine dump near the existing Gromis Substation. The only major change to the natural landscape is the Buffels River valley which is proposed to be crossed by the double-circuit 132kV power line in the north. The power line would run parallel to the Juno Gromis 400 kV power line due to be constructed shortly. Figures 3 to 5 show the character of the 300m corridor.

The archaeological cultural landscape should also be considered, although it is not typically visible. This cultural landscape consists of a multitude of individual archaeological sites classifiable as a Type 3 precolonial cultural landscape (Orton 2016). Figure 24 shows another view of Figure 7 but with the newly reported sites (identified during the site visit[6]) added onto it. It is clear that with wider survey this landscape would be shown to host many more sites, although densities would naturally reduce away from the sea.

[6] The site visit considered two wind farms and two power lines (largely within the same corridor), but just one power line is reported on here.

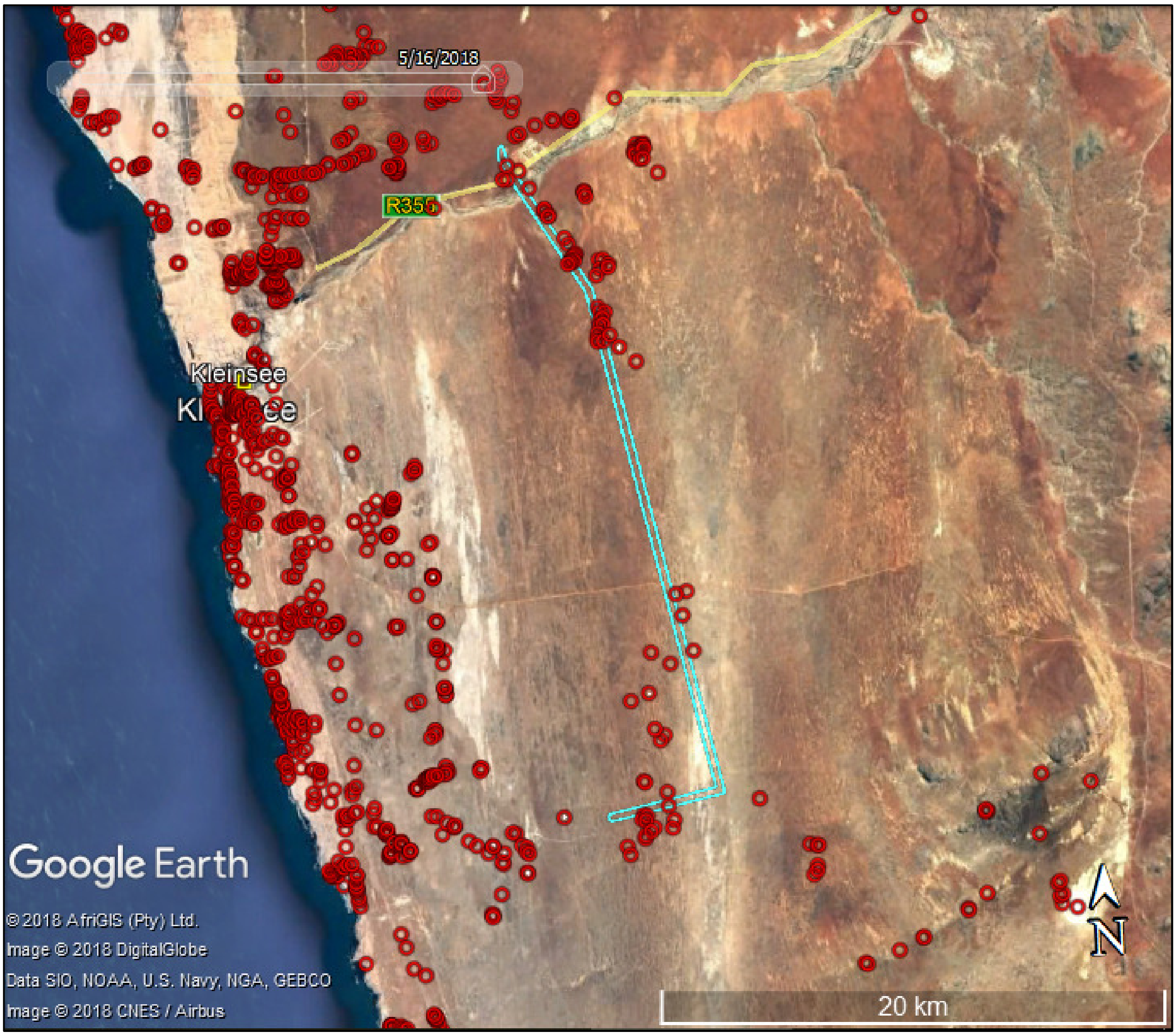

Figure 24: *Aerial view of the 300m corridor and wider surroundings showing previously known archaeological resources as well as those discovered during the survey for the proposed grid connection infrastructure and associated wind farms. 300m corridor in turquoise.*

It is important to note that the 300m corridor lies within a REDZ and that renewable energy developments and their associated electrical infrastructure are therefore expected to be focussed in this area. A number of developments are proposed with two already authorised. With construction of these facilities a new 'layer' would be added to the cultural landscape which will intensify the presence of industrial and infrastructure development within the area. Also, the 400 kV Eskom power line (i.e. Juno Gromis 400kV power line) that the 300m corridor follows, has been authorised and will be constructed in the near future.

6.6. Summary of heritage indicators

The only palaeontological resources of concern are isolated bones from the middle and late Quaternary that may occur within any of the sand units present in the 300m corridor. The most frequent heritage resources present are small LSA archaeological sites. They are scattered throughout the dune areas in variable densities but tend to be largely absent from the flat plains.

While no graves older than 60 years were discovered, unmarked precolonial graves could be present almost anywhere in the study area (i.e. 300m corridor). Some structures older than 60 years are present in the area but located well away from the 300m corridor. The cultural landscape is minimally developed and is regarded as a remote, inhospitable natural landscape. Because of its very rich archaeological history, the landscape is considered to be a precolonial cultural landscape.

6.7. Statement of significance and provisional grading

Section 38(3)(b) of the NHRA requires an assessment of the significance of all heritage resources. In terms of Section 2(vi), ''cultural significance'' means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance. Note that, in line with the SAHRA grading system, only archaeological and palaeontological heritage is assigned provisional grades.

Any fossil bones found would have high cultural significance for their scientific value and would be rated as 'GP A' resources.

The archaeological resources are deemed to have medium cultural significance for their scientific value. Those more important sites can be assigned a field rating of 'GP A', but many others are considered to be 'GP B' or 'GP C'.

Graves (older than 60 years) are deemed to have high cultural significance for their social value but none are yet known from the 300m corridor. They would be allocated a rating of IIIA.

The built environment is deemed to be of low cultural significance for its architectural, historical and social values.

The historical/recent cultural landscape is deemed to have low-medium cultural significance for its aesthetic value but the archaeological cultural landscape is of medium significance for its scientific value and could be assigned a field rating of IIIB.

7. ASSESSMENT OF IMPACTS

This section assesses the significance of the expected impacts associated with the development of the proposed grid connection infrastructure.

7.1. Impacts to palaeontological resources

Impacts to palaeontological resources would occur only during the construction phase when foundations are excavated and the service road cleared. The impacts would be direct since the excavations might damage or destroy fossils as they are uncovered. The probability of impacts occurring is probable with the resultant significance of impacts being **Low**. With mitigation, the status becomes positive because of the potential gain in knowledge from access to deposits and fossils that would otherwise have remained buried and undiscovered. The significance would be **Low**. There are no fatal flaws expected from a palaeontological perspective. The impact assessment summary for palaeontology is shown in Table 3.

Table 3: *Assessment of palaeontological impacts.*

Nature: Direct destruction of or damage to fossil bones or other palaeontological resources through excavation of foundations and clearing of service roads.		
	Without mitigation	**With mitigation**
Extent	Local (2)	Local (2). If important fossil find occurs, the rating becomes regional-international (3-5)
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (4)	Low (4)
Probability	Improbable (2)	Improbable (2)
Significance	**22 (Low)**	**22 (Low)**
Status (positive or negative)	Negative	Positive
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Yes	Partly
Can impacts be mitigated?	Yes, but only partial mitigation is possible. Valuable fossils may be lost in spite of management actions to mitigate such loss.	
Mitigation: » Monitoring of all construction-phase excavations by project staff and ECO. » Inspection, sampling and recording of selected exposures in the event of fossil finds. » Reports and fossils deposited in scientific institution.		
Residual Impacts: It will never be possible to spot and rescue all fossils which means that there will always be some loss and therefore residual impact. This would be of unknown significance because of the sparse distribution of fossils in the broader landscape. Positive impacts would continue to be felt with successful mitigation because of the scientific implications of the resulting research opportunities.		

Measures for inclusion in the EMPr are as follows:

OBJECTIVE: To see and rescue fossil material that may be exposed in the excavations made for the construction of the grid connection infrastructure.	
Project component/s	Pylon and substation foundation excavations and service road clearing.
Potential Impact	Loss of fossils through going unnoticed and/ or destroyed.
Activity/risk source	All bulk earthworks.
Mitigation: Target/Objective	To facilitate the likelihood of noticing fossils and ensure appropriate actions in terms of the relevant legislation.

Mitigation: Action/control	**Responsibility**	**Timeframe**
Inform staff of the need to watch for potential fossil occurrences.	The developer ECO and contractors.	Pre-construction.
Inform staff of the Fossil Finds Procedures to be followed in the event of fossil occurrences.	ECO/specialist.	Pre-construction.
Monitor for the presence of fossils.	Contracted personnel and ECO.	Construction.
Liaise with palaeontologist on the nature of potential finds and appropriate actions.	ECO and specialist, SAHRA.	Construction.
Obtain a permit from SAHRA for the fossil finds collection should resources be discovered.	Developer/Specialist.	Construction
Excavate main finds, inspect pits and record and sample excavations.	Specialist.	Construction.

Performance Indicator	• Reporting of and liaison about possible fossil finds. • Fossils noticed and rescued. • Scientific record of fossil contexts and temporary exposures in earthworks.
Monitoring	• Ensure staff are aware of fossils and the procedure to follow when found. • ECO to conduct inspections of open excavations whenever on site.

7.2. Impacts to archaeological resources

Impacts to archaeological resources would occur only during the construction phase when foundations are excavated and the service road is cleared. The impacts would be direct since the excavations might damage or destroy archaeological materials. The probability of impacts occurring is probable with the resultant significance of impacts being **Medium**. With mitigation the magnitude and probability of the impact would be reduced and the significance will become **Low**. There are no fatal flaws expected to occur with regards to archaeological resources. The impact assessment summary for archaeological resources is shown in Table 4.

Table 4: *Assessment of archaeological impacts.*

Nature: Direct destruction of or damage to archaeological resources during excavation of foundations and clearing of service roads.

	Without mitigation	**With mitigation**
Extent	Local (2)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (4)	Minor (2)
Probability	Probable (3)	Improbable (2)
Significance	**33 (Medium)**	**16 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	

Mitigation:

- » A walk down survey of the final authorised double-circuit 132kV power line alignment and collector substation location must be undertaken; and
- » Any mitigation still required should be effected prior to construction.

Residual Impacts: Entirely buried archaeological sites within the 300m corridor would likely be damaged or destroyed but the chances of significant buried sites being present in this landscape is deemed to be very low. Impacts to remaining materials after mitigation has been carried out at specific sites are insignificant.

Measures for inclusion in the EMPr are as follows:

OBJECTIVE: To ensure that impacts to archaeological sites and materials are minimised during construction of the grid connection infrastructure.	
Project component/s	All infrastructure.
Potential Impact	Archaeological sites and materials may be damaged and/or destroyed during earthworks.
Activity/risk source	All earthworks and surface clearing.
Mitigation: Target/Objective	Successful location, evaluation and sampling of archaeological materials as required.

Mitigation: Action/control	Responsibility	Timeframe
Ensure that a preconstruction walk-down survey is carried out	Developer and Specialist.	Pre-construction – at least 6 months before construction.
Obtain permits from SAHRA for any required mitigation, including excavation.	Specialist.	Pre-construction – at least 4-5 months before construction
Carry out mitigation excavations.	Specialist.	Pre-construction – at least 3-4 months before construction.

Performance Indicator	• Successful completion of mitigation work • Negligible loss of known significant archaeological resources.
Monitoring	None.

7.3. Impacts to graves

Impacts on graves would occur only during the construction phase when foundations are excavated and land is cleared for service roads. The impacts would be direct since the excavations might damage or destroy graves. The probability of impacts occurring is very improbable with the resultant significance of impacts being **Low**. With mitigation the magnitude of the impact would be reduced but the significance will remain **Low**. There are no fatal flaws for the development considering graves. The impact assessment summary for graves is shown in Table 5.

Table 5: *Assessment of impacts to graves.*

Nature: Direct destruction of or damage to graves during excavation of foundations and clearing of service roads.		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Very high (10)	Moderate (6)
Probability	Very improbable (1)	Very improbable (1)
Significance	**16 (Low)**	**12 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: Rescue of any graves found during construction.		
Residual Impacts: There may still be graves that are not seen during earthworks and that get lost entirely.		

Measures for inclusion in the EMPr are as follows:

OBJECTIVE: To ensure that graves are rescued during the construction of the grid connection infrastructure.	
Project component/s	All infrastructure.
Potential Impact	Graves may be damaged and/or destroyed during earthworks.
Activity/risk source	All earthworks and surface clearing.
Mitigation: Target/Objective	Successful location, evaluation and rescue as required.

Mitigation: Action/control	Responsibility	Timeframe
Ensure that any graves found are immediately protected *in situ* and reported to an archaeologist or SAHRA.	ECO and project staff.	Immediately on discovery of grave.
Obtain permit from SAHRA for exhumation of remains.	Specialist.	Immediately on discovery of grave.
Carry out exhumation and recording of grave.	Specialist.	As soon as permit is approved.

Performance Indicator	Successful rescue of burials.
Monitoring	None.

7.4. Impacts to the cultural landscape

This section does not include the precolonial cultural landscape which is effectively covered by Section 7.1 dealing with archaeology. Impacts to the cultural landscape would occur during all phases of the proposed project. Impacts would arise due to the presence in the landscape of incompatible features (i.e. the power line and substation) and from the clearing of natural vegetation for the service road and substation. The impacts would be direct and occur both through the destruction of elements of the natural landscape such as vegetation and dunes and through contextual impacts where the visual qualities of the landscape deteriorate as a result of the presence of incompatible infrastructure and equipment. If the power line and substation are built then the impacts will definitely occur. However, because the double-circuit 132kV power line would be constructed alongside an already authorised and much larger power line the clustering of lines means that the impact is less likely to be an issue. As such, the probability of the impact occurring has been reduced. The resultant significance of impacts would be of **medium** significance. With mitigation, which would aim to reduce visual scarring, the magnitude of the impact would be reduced slightly and the significance becomes **low**. Due to the fact that the area has been identified for renewable energy development through a Strategic Environmental Assessment, power lines and substations (and wind farms) can be expected to occur here and there are therefore no fatal flaws in terms of the cultural landscape. The impact assessment summary for the cultural landscape is shown in Table 6.

Table 6: *Assessment of cultural landscape impacts.*

Nature: ***Direct impacts to the landscape through the introduction of generally incompatible electrical infrastructure (power lines and substation).***		
	Without mitigation	**With mitigation**
Extent	Local (2)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Moderate (4)	Low (2)
Probability	Probable (3)	Improbable (2)
Significance	**30 (Medium)**	**14 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Not fully	
Mitigation: » Mitigation measures should include rehabilitation of any disturbed areas not in use during operation		

and any other measures as listed in the Visual Impact Assessment.
Residual Impacts: Regardless of mitigation measures, the power line and substation will still be visible in the cultural landscape and therefore create an impact.

Measures for inclusion in the EMPr should be as specified by the visual assessment practitioner and should aim to reduce visual scarring of the landscape.

7.5. Cumulative impacts

This section considers all cumulative impacts to heritage resources as mentioned in the preceding tables and that would occur through the development of multiple renewable energy facilities and the associated power lines and substations in the area (Figure 25). The assessment is effectively an average of the negative and positive impacts related to each relevant type of heritage (Table 7).

Cumulative Impacts to palaeontology are likely to be of low significance because of the generally sparse distribution of fossils in the broader landscape. With mitigation the significance is reduced because of the positive aspect of rescuing scientific samples and the retrieval of data. Nevertheless, negative impacts will continue to accumulate when numerous projects commence with construction.

The development of many renewable energy projects and grid connection infrastructure in the area could result in the loss of many archaeological sites. Although data from coastal and near-coastal archaeological sites is sufficiently available, the loss of many sites further away from the coast where most energy-related developments are planned (Figure 25) could result in significant cumulative impacts if no mitigation is carried out. It is also notable that the density of archaeological sites reduces away from the coast with impacts becoming consequently less likely. Although impacts to individual archaeological sites are still negative after mitigation, if many sites are sampled over multiple renewable energy projects then a positive cumulative impact could be realised because of the advance of scientific knowledge that may result from the mitigation work.

Because graves are very sparsely distributed, very few get impacted. This means that cumulative impacts are of low significance.

Several other wind farms have been proposed in the region but clustering of impacts is more desirable than spreading them widely from a cultural landscape perspective. Although cumulative impacts are likely to occur, having them concentrated reduces their significance. Also, the area is a declared REDZ which means that clustering of energy-related developments here will help reduce impacts in other areas and the associated cultural landscapes.

Overall the impacts to all heritage for the proposed grid connection infrastructure alone are considered to be of low significance (28), while impacts when considering all proposed projects would calculate to medium (60). Because of the diversity of heritage resources, the effectiveness of mitigation measures is likely to be variable with archaeology and graves being the easiest to successfully mitigate. Effective mitigation of palaeontology relies on the reporting of fossils found during earthworks. While it is impossible to hide the grid connection infrastructure in the landscape, a small degree of mitigation can be effected through the application of best practice measures such as the rehabilitation of disturbed areas not required during operation.

Table 7: *Assessment of cumulative heritage impacts.*

Nature: Direct impacts to fossils, archaeology and graves during construction work and direct impacts to the landscape through the introduction of generally incompatible electrical infrastructure.		
	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects in the area**
Extent	Local (1)	Local (3)
Duration	Long-term (4)	Long-term (4)
Magnitude	Minor (2)	Moderate (5)
Probability	Highly probable (4)	Definite (5)
Significance	**28 (Low)**	**60 (Medium)**
Status (positive or negative)	Negative (but with some positive aspects after mitigation)	Negative (but with some positive aspects after mitigation)
Reversibility	Low for some aspects and high for others	Low for some aspects and high for others
Irreplaceable loss of resources?	Yes for some aspects and no for others	Yes for some aspects and no for others
Can impacts be mitigated?	Yes for some aspects and no for others	Yes for some aspects and no for others
Mitigation: Mitigation measures are as per the individual types of heritage assessed above. Such measures should be applied at all renewable energy facilities.		
Residual Impacts: Residual impacts are as per the individual types of heritage assessed above. They would apply equally to all renewable energy projects.		

7.6. Levels of acceptable change

Any impact to an archaeological or palaeontological resource or a grave is deemed unacceptable until such time that the resource has been inspected and studied further if necessary. Impacts to the landscape are difficult to quantify but in general a development that visually dominates the landscape from many vantage points is undesirable. Because of the relative visual permeability of the proposed grid connection infrastructure, such an impact is unlikely. The landscape in the north and on the coast to the northwest has already been considerably altered by mining in the past.

From a cumulative perspective, large numbers of archaeological sites have been lost to mining in the area but with the implementation of mitigation projects scientific knowledge regarding the prehistory of the area has advanced considerably. Overall, so long as the vast majority of sites do get found and are rescued then this impact would be deemed acceptable.

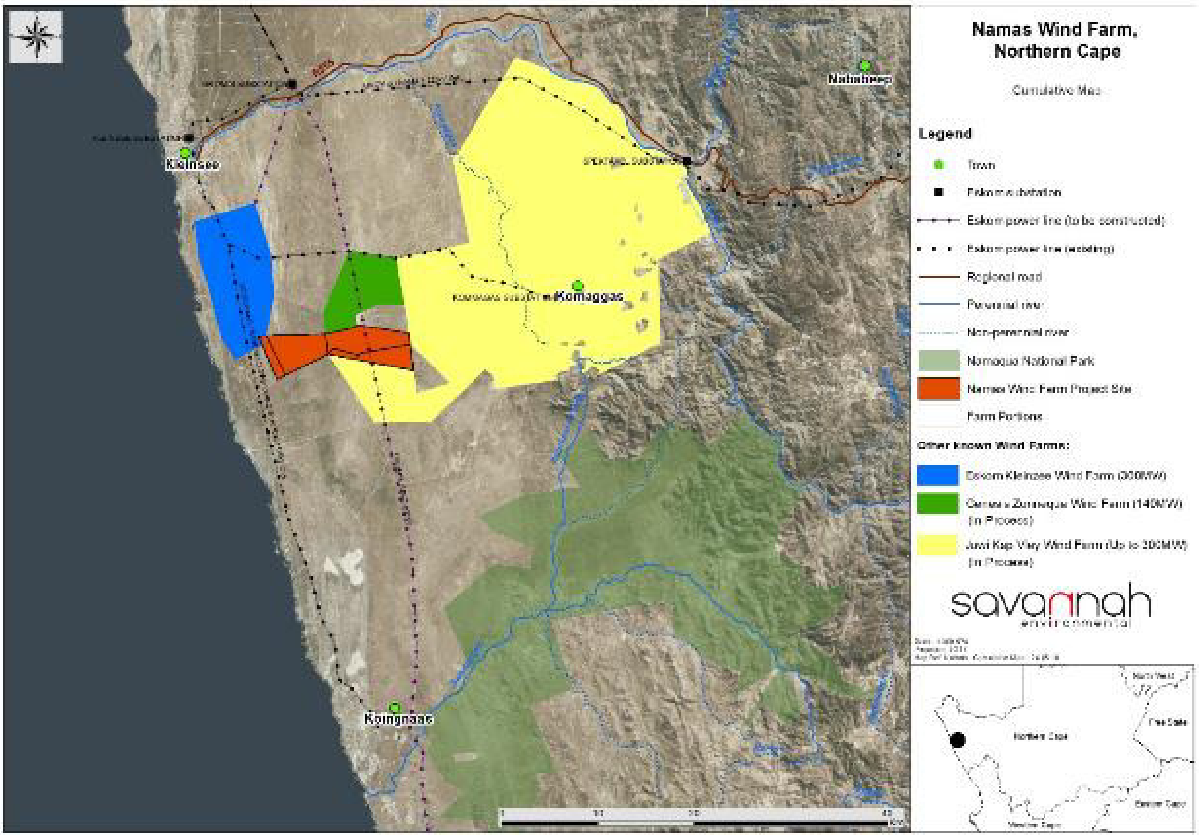

Figure 25: *Map showing other proposed and authorised renewable energy facilities in the Kleinsee-Komaggas area as well as proposed and existing power lines. The Eskom Kleinsee Wind Farm and the Juwi Kap Vley Wind Farm are the only faciliies to receive authorisation to date, the other facilities are still in process.*

7.7. Existing impacts to heritage resources

The study area (i.e. 300m corridor) is currently used for small livestock grazing (including sheep farming). Animals move over archaeological sites which results in trampling and displacement of archaeological materials. This leads to a very slow degradation in the scientific value and significance of the archaeological sites present. The cultural landscape has been impacted by mining activities but this is focused in the north of the 300m corridor as well as further away on the coastline to the northwest.

8. EVALUATION OF IMPACTS RELATIVE TO SUSTAINABLE SOCIAL AND ECONOMIC BENEFITS

Section 38(3)(d) of the NHRA requires an evaluation of the impacts on heritage resources relative to the sustainable social and economic benefits to be derived from the development. The project would assist with the provision of energy to South Africa which is needed for economic development. It would also provide a number of construction phase jobs and possibly a small number of longer term jobs during the operation phase. Because the impacts to heritage are manageable and can generally be mitigated it is considered that the social and economic benefits outweigh the impacts to heritage resources expected with the development of the proposed grid connection infrastructure.

9. CONCLUSIONS

Palaeontological and archaeological resources are the main concerns for this proposed development, although fossils are rather less likely to be found than archaeological sites. While fossils would be revealed by excavations during construction and would require reporting when found, archaeological sites will be readily located during a final pre-construction survey and can be rescued through archaeological excavation before construction starts. Because the study area (i.e. 300m corridor) falls within a REDZ, the development of electrical infrastructure is expected and such infrastructure will be clustered in the area. There are no fatal flaws and the development is acceptable from a heritage perspective, subject to the implementation of the recommended mitigation measures. With a few exceptions, buffers[7] around known archaeological sites have been respected (Figure A3.6 & A3.7) and no further buffers require implementation. The exceptions lie along the northern part of the 300m corridor and would require mitigation (Figure A3.8 & A3.9).

9.1. Reasoned opinion of the specialist

Because some impacts can be readily managed or mitigated and those remaining are not of high significance, it is suggested that, from a heritage point of view, the project should be authorised in full.

10. RECOMMENDATIONS

It is recommended that the proposed grid connection infrastructure should be authorised but subject to the following conditions which should be included in the conditions of authorisation or the environmental management program as appropriate:

- An archaeologist should be appointed to conduct a final pre-construction survey of the approved layout (i.e. the route of the double-circuit 132kV power line and the location of the collector substation within the 300m corridor) at least 6 months prior to commencement of construction;
- A chance finds procedure must be implemented for the rescuing of any fossils discovered during construction;
- All work is to be carried out within the authorised construction footprint (i.e. 300m corridor). Any new areas, outside of the 300m corridor, that may need to be disturbed must be surveyed for archaeological sites prior to disturbance;
- Any disturbed areas not required during operation must be rehabilitated after construction; and
- If any archaeological material or human burials are uncovered during the course of development then work in the immediate area should be halted. The find would need to be reported to the heritage authorities and may require inspection by an archaeologist.

[7] Buffers were set at 50 m from the waypoint in order to allow for the area of the sites plus a 30 m buffer zone.

Such heritage is the property of the state and may require excavation and curation in an approved institution.

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APPENDIX 1 – Curriculum Vitae

Curriculum Vitae

Jayson David John Orton

ARCHAEOLOGIST AND HERITAGE CONSULTANT

Contact Details and personal information:

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Email:	jayson@asha-consulting.co.za
Birth date and place:	22 June 1976, Cape Town, South Africa
Citizenship:	South African
ID no:	760622 522 4085
Driver's License:	Code 08
Marital Status:	Married to Carol Orton
Languages spoken:	English and Afrikaans

Education:

SA College High School	Matric	1994
University of Cape Town	B.A. (Archaeology, Environmental & Geographical Science)	1997
University of Cape Town	B.A. (Honours) (Archaeology)*	1998
University of Cape Town	M.A. (Archaeology)	2004
University of Oxford	D.Phil. (Archaeology)	2013

*Frank Schweitzer memorial book prize for an outstanding student and the degree in the First Class.

Employment History:

Spatial Archaeology Research Unit, UCT	Research assistant	Jan 1996 – Dec 1998
Department of Archaeology, UCT	Field archaeologist	Jan 1998 – Dec 1998
UCT Archaeology Contracts Office	Field archaeologist	Jan 1999 – May 2004
UCT Archaeology Contracts Office	Heritage & archaeological consultant	Jun 2004 – May 2012
School of Archaeology, University of Oxford	Undergraduate Tutor	Oct 2008 – Dec 2008
ACO Associates cc	Associate, Heritage & archaeological consultant	Jan 2011 – Dec 2013
ASHA Consulting (Pty) Ltd	Director, Heritage & archaeological consultant	Jan 2014 –

Professional Accreditation:

Association of Southern African Professional Archaeologists (ASAPA) membership number: 233
CRM Section member with the following accreditation:

- Principal Investigator: Coastal shell middens (awarded 2007)
  Stone Age archaeology (awarded 2007)
  Grave relocation (awarded 2014)
- Field Director: Rock art (awarded 2007)
  Colonial period archaeology (awarded 2007)

Association of Professional Heritage Practitioners (APHP) membership number: 43

- Accredited Professional Heritage Practitioner

➢ *Memberships and affiliations:*

South African Archaeological Society Council member	2004 – 2016
Assoc. Southern African Professional Archaeologists (ASAPA) member	2006 –
UCT Department of Archaeology Research Associate	2013 –
Heritage Western Cape APM Committee member	2013 –
UNISA Department of Archaeology and Anthropology Research Fellow	2014 –
Fish Hoek Valley Historical Association	2014 –
Kalk Bay Historical Association	2016 –
Association of Professional Heritage Practitioners member	2016 –

Fieldwork and project experience:

Extensive fieldwork and experience as both Field Director and Principle Investigator throughout the Western and Northern Cape, and also in the western parts of the Free State and Eastern Cape as follows:

Feasibility studies:

- Heritage feasibility studies examining all aspects of heritage from the desktop

Phase 1 surveys and impact assessments:

- Project types
  - Notification of Intent to Develop applications (for Heritage Western Cape)
  - Desktop-based Letter of Exemption (for the South African Heritage Resources Agency)
  - Heritage Impact Assessments (largely in the Environmental Impact Assessment or Basic Assessment context under NEMA and Section 38(8) of the NHRA, but also self-standing assessments under Section 38(1) of the NHRA)
  - Archaeological specialist studies
  - Phase 1 archaeological test excavations in historical and prehistoric sites
  - Archaeological research projects
- Development types
  - Mining and borrow pits
  - Roads (new and upgrades)
  - Residential, commercial and industrial development
  - Dams and pipe lines
  - Power lines and substations
  - Renewable energy facilities (wind energy, solar energy and hydro-electric facilities)

Phase 2 mitigation and research excavations:

- ESA open sites
  - Duinefontein, Gouda, Namaqualand
- MSA rock shelters
  - Fish Hoek, Yzerfontein, Cederberg, Namaqualand
- MSA open sites
  - Swartland, Bushmanland, Namaqualand
- LSA rock shelters
  - Cederberg, Namaqualand, Bushmanland
- LSA open sites (inland)
  - Swartland, Franschhoek, Namaqualand, Bushmanland
- LSA coastal shell middens
  - Melkbosstrand, Yzerfontein, Saldanha Bay, Paternoster, Dwarskersbos, Infanta, Knysna, Namaqualand
- LSA burials
  - Melkbosstrand, Saldanha Bay, Namaqualand, Knysna
- Historical sites
  - Franschhoek (farmstead and well), Waterfront (fort, dump and well), Noordhoek (cottage), variety of small excavations in central Cape Town and surrounding suburbs
- Historic burial grounds
  - Green Point (Prestwich Street), V&A Waterfront (Marina Residential), Paarl

Awards:

Western Cape Government Cultural Affairs Awards 2015/2016: Best Heritage Project.

APPENDIX 2: PALAEONTOLOGICAL SPECIALIST STUDY

PALAEONTOLOGICAL IMPACT ASSESSMENT
(DESKTOP STUDY)

PROPOSED GENESIS NAMAS AND ZONNEQUA WIND FARMS
NAMAKWA DISTRICT MUNICIPALITY, NORTHERN CAPE

By

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FINAL VERSION
3 September 2018

EXECUTIVE SUMMARY

1. Site Names

Genesis Namas Wind (Pty) Ltd (Namas Wind Farm) and Genesis Zonnequa Wind (Pty) Ltd. (Zonnequa Wind Farm).

2. Location

The proposed wind farms are located about 20 km southeast of Kleinsee in the Nama Khoi Local Municipality, Namakwa District Municipality, Northern Cape Province (Figure 1). The properties involved are:

Namas Wind Farm: Rooivlei 3/327 and RE/327; Zonnekwa 3/328 and 4/328.
Zonnequa Wind Farm: Zonnekwa RE/326; Zonnekwa 1/328.
Wind Farms mapsheets: 2917CC BRAZIL and 2917CD KOMAGGAS.
Power line corridor mapsheet: 2916DB & 2917CA KLEINSEE.

3. Locality Plan

See Figure 2.

4. Proposed Development

The proposed Namas Wind Farm involves up to 43 wind turbines, and up to 56 turbines are envisaged for the Zonnequa Wind Farm (Figure 2). Concomitant infrastructure entails access roads, construction laydown areas, cabling trenches, control stations, workshop and offices. The power lines to the ESKOM grid are intended to proceed along the existing ESKOM Gromis-Juno corridor to the Gromis substation (Figure 1) (the 400kV Gromis-Juno power line has been authorised and will be constructed within the near future). The power lines for the wind farms are assessed as 300m power line corridors. Each facility will have its own power line to connect to the grid.

5. Palaeontological Heritage Resources Identified

The affected surficial formations include early to mid-Holocene dunes of the **Hardevlei Formation** and earlier late Quaternary coversands of the **Koekenaap Formation**. Beneath these unconsolidated sands are compact, pedogenically-altered aeolianites termed "**Dorbank Formations**" which are fossil dune plumes of later mid-Quaternary age. An older dorbank dune plume underlies the eastern part of the Project Area; a later dorbank dune plume underlies the western part where most of the turbines will be situated (Figures 2 to 6). Between these dune plume ridges is a non-depositional area which is closely underlain by pale pedocrete which is likely to have formed in early mid-Quaternary aeolianites equivalent to the **Olifantsrivier Formation**.

6. Anticipated Impacts

The primary palaeontological concern is the fossil bones that are sparsely distributed in these aeolian deposits. Although sparse in aeolian Dorbank formations and overlying coversands and dunes, they are of high scientific value and important for palaeoclimatic, palaeobiological and biostratigraphic studies. The fossil material in these deposits is a sample of the middle and late Quaternary fauna of the Namaqualand coast.

The dimensions of the wind turbine foundation slabs are 20 X 20 X 3 m. There will be a considerable number of them (~99) distributed over and "sampling" a wide area. Therefore, in spite of the overall low fossil potential, there is a distinct possibility that buried palaeosurfaces bearing fossil bones and archaeological material may be exposed in some of the excavations.

The excavations for cabling and other infrastructure are shallow and mainly affect the coversands, but the cabling trenches will traverse considerable lengths across the Project Area and intersect the locally-fossiliferous top of the Dorbank Unit in places. The footings of the transmission line pylons that connect to the grid are likely to be minor in scale and have a low likelihood of impact, although not altogether absent.

NATURE OF IMPACT SUMMARY		
	Without mitigation	**With mitigation**
Significance	Medium	Medium
Status	Negative	Positive
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Yes	Partly
Can impacts be mitigated?	Yes, but only partial mitigation is possible. Valuable fossils may be lost in spite of management actions to mitigate such loss.	
Mitigation:	• Monitoring of all construction-phase excavations. • Inspection, sampling and recording of selected exposures in the event of fossil finds. • Fossil finds and contextual reports deposited in a curatorial scientific institution.	
Cumulative impact	• The inevitable and permanent loss of fossils.	

7. Recommendations

The Medium/moderate level of significance indicates that the palaeontological impact does not greatly influence the decision to develop the area, but appropriate mitigation measures are required. Therefore, the development of the wind farms within the project sites is considered to be acceptable from a palaeontological perspective and can be authorised, subject to the implementation of the recommended mitigation measures. It is recommended that a requirement to be alert for possible fossils and buried archaeological material be included in the EMPr for the Construction Phase of the proposed Namas and Zonnequa Wind Farms and Powerlines, with a Fossil Finds Procedure (Appendix 3) in place.

The field supervisor/foreman and workers involved in digging excavations must be informed of the need to look out for fossils and buried potential archaeological material. Workers seeing potential objects are to cease work at that spot and to report to the field supervisor who, in turn, will report to the Environmental Control Officer (ECO). The ECO will inform the developer and contact the palaeontologist contracted to be on standby in the case of fossil finds. The latter will liaise with SAHRA on the nature of the find and consequent actions (permitting and collection of find).

If palaeontological mitigation is applied to this project as recommended, it is possible that these developments will to some extent alleviate the negative cumulative impact on paleontological resources in the region. The history of these vast tracts of sands, gravels and pedocretes of the Northern Cape is very poorly known, with very few fossils to rely on. Therefore, though of low probability, any find will be of considerable importance and could possibly add to the scientific knowledge of the area in a positive manner.

DECLARATION OF INDEPENDENCE

PALAEONTOLOGICAL IMPACT ASSESSMENT REPORT (Desktop Study).
PROPOSED GENESIS NAMAS AND ZONNEQUA WIND FARMS, NAMAKWA DISTRICT MUNICIPALITY, NORTHERN CAPE.

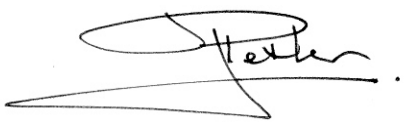
Terms of Reference

This assessment forms part of the Heritage Impact Assessment and it assesses the overall palaeontological (fossil) sensitivities of formations underlying the Project Area in terms of the proposed development.

Declaration

I …**John Pether**……, as the appointed independent specialist hereby declare that I:

» act/ed as the independent specialist in the compilation of the above report;
» regard the information contained in this report as it relates to my specialist input/study to be true and correct, and
» do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
» have and will not have any vested interest in the proposed activity proceeding;
» have disclosed to the EAP any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management act;
» have provided the EAP with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not; and
» am aware that a false declaration is an offence in terms of regulation 48 of the 2014 NEMA EIA Regulations.



Signature of the specialist

Date: 3 September 2018

CURRICULUM VITAE

John Pether, M.Sc., Pr. Sci. Nat. (Earth Sci.)

Independent Consultant/Researcher recognized as an authority with 37 years' experience in the field of coastal-plain and continental-shelf palaeoenvironments, fossils and stratigraphy, mainly involving the West Coast/Shelf of southern Africa. Has been previously employed in academia (South African Museum) and industry (Trans Hex, De Beers Marine). At present an important involvement is in Palaeontological Impact Assessments (PIAs) and mitigation projects in terms of the National Heritage Resources Act 25 (1999) (~250 PIA reports to date) and is an accredited member of the Association of Professional Heritage Practitioners (APHP). Continues to be involved as consultant to offshore and onshore marine diamond exploration ventures. Expertise includes:

- Coastal plain and shelf stratigraphy (interpretation of open-pit exposures, on/offshore cores and exploration drilling).
- Sedimentology and palaeoenvironmental interpretation of shallow marine, aeolian and other terrestrial surficial deposits.
- Marine macrofossil taxonomy (molluscs, barnacles, brachiopods) and biostratigraphy.
- Marine macrofossil taphonomy.
- Sedimentological and palaeontological field techniques in open-cast mines (including finding and excavation of vertebrate fossils (bones).

Membership of Professional Bodies

- South African Council of Natural Scientific Professions. Earth Science. Reg. No. 400094/95.
- Geological Society of South Africa.
- Palaeontological Society of Southern Africa.
- Southern African Society for Quaternary Research.
- Association of Professional Heritage Practitioners (APHP), Western Cape. Accredited Member No. 48.

Past Clients Palaeontological Assessments

AECOM SA (Pty) Ltd.	Guillaume Nel. Env. Management Consultants.
Agency for Cultural Resource Management (ACRM).	Klomp Group.
AMATHEMBA Environmental.	Megan Anderson, Landscape Architect.
Anél Blignaut Environmental Consultants.	Ninham Shand (Pty) Ltd.
Arcus Gibb (Pty) Ltd.	PD Naidoo & Associates (Pty) Ltd.
ASHA Consulting (Pty) Ltd.	Perception Environmental Planning.
Aurecon SA (Pty) Ltd.	PHS Consulting.
BKS (Pty) Ltd. Engineering and Management.	Resource Management Services.
Bridgette O'Donoghue Heritage Consultant.	Robin Ellis, Heritage Impact Assessor.
Cape Archaeology, Dr Mary Patrick.	Savannah Environmental (Pty) Ltd.
Cape EAPrac.	Sharples Environmental Services cc
CCA Environmental (Pty) Ltd.	Site Plan Consulting (Pty) Ltd.
Centre for Heritage & Archaeological Resource Management	Strategic Environmental Focus (Pty) Ltd.
Chand Environmental Consultants.	UCT Archaeology Contracts Office (ACO).
CK Rumboll & Partners.	UCT Environmental Evaluation Unit
CNdV Africa	Urban Dynamics.
CSIR - Environmental Management Services.	Van Zyl Environmental Consultants
Digby Wells & Associates (Pty) Ltd.	ENVIRO DINAMIK.
Enviro Logic	Wethu Investment Group Ltd.
Environmental Resources Management SA (ERM).	Withers Environmental Consultants.
Greenmined Environmental	

Stratigraphic consulting including palaeontology

Afri-Can Marine Minerals Corp	Council for Geoscience
De Beers Marine (SA) Pty Ltd.	De Beers Namaqualand Mines.
Geological Survey Namibia	IZIKO South African Museum.
Namakwa Sands (Pty) Ltd	NAMDEB

CONTENTS

GLOSSARY

~ (tilde): Used herein as "approximately" or "about".

Aeolian: Pertaining to the wind. Refers to erosion, transport and deposition of sedimentary particles by wind. A rock formed by the solidification of aeolian sediments is an aeolianite.

Alluvium: Sediments deposited by a river or other running water (alluvial).

Archaeology: Remains resulting from human activity which are in a state of disuse and are in or on land and which are older than 100 years, including artefacts, human and hominid remains and artificial features and structures.

asl.: above (mean) sea level.

Bedrock: Hard rock formations underlying much younger sedimentary deposits.

Calcareous: sediment, sedimentary rock, or soil type which is formed from or contains a high proportion of calcium carbonate in the form of calcite or aragonite.

Calcrete: An indurated deposit (duricrust) mainly consisting of Ca and Mg carbonates. The term includes both pedogenic types formed in the near-surface soil context and non-pedogenic or groundwater calcretes related to water tables at depth.

Clast: Fragments of pre-existing rocks, *e.g*. sand grains, pebbles, boulders, produced by weathering and erosion. Clastic – composed of clasts.

Colluvium: Hillwash deposits formed by gravity transport downhill. Includes soil creep, sheetwash, small-scale rainfall rivulets and gullying, slumping and sliding processes that move and deposit material towards the foot of the slopes.

Conglomerate: A cemented gravel deposit.

Coversands: Aeolian blanket deposits of sandsheets and smaller dunes.

Duricrust: A general term for a zone of chemical precipitation and hardening formed at or near the surface of sedimentary bodies through pedogenic and (or) non-pedogenic processes. It is formed by the accumulation of soluble minerals deposited by mineral-bearing waters that move upward, downward, or laterally by capillary action, commonly assisted in arid settings by evaporation. Classified into calcrete, ferricrete, silcrete, gypcrete, sepiocrete etc.

Ferricrete: Indurated deposit (duricrust) consisting predominantly of accumulations of iron sesquioxides, with various dark-brown to yellow-brown hues. It may form by deposition from solution or as a residue after removal of silica and alkalis. Like calcrete it has pedogenic and groundwater forms. Synonyms are laterite, iron pan or "koffieklip".

Fluvial deposits: Sedimentary deposits consisting of material transported by, suspended in and laid down by a river or stream.

Fm.: Formation.

Fossil: The remains of parts of animals and plants found in sedimentary deposits. Most commonly hard parts such as bones, teeth and shells which in lithified sedimentary rocks are usually altered by petrification (mineralization). Also impressions and mineral films in fine-grained sediments that preserve indications of soft parts. Fossils plants include coals, petrified wood and leaf impressions, as well as microscopic pollen and spores. Marine sediments contain a host of microfossils that reflect the plankton of the past and provide records of ocean changes. Nowadays also includes molecular fossils such as DNA and biogeochemicals such as oils and waxes.

Heritage: That which is inherited and forms part of the National Estate (Historical places, objects, fossils as defined by the National Heritage Resources Act 25 of 1999).

OSL: Optically stimulated luminescence. One of the radiation exposure dating methods based on the measurement of trapped electronic charges that accumulate in crystalline materials as a result of low-level natural radioactivity from U, Th and K. In OSL dating of aeolian quartz and feldspar sand grains, the trapped charges are zeroed by exposure to daylight at the time of deposition. Once buried, the charges accumulate and the total radiation exposure (total dose) received by the sample is estimated by laboratory measurements. The level of radioactivity (annual doses) to which the sample grains have been exposed is measured in the field or from the separated minerals containing radioactive elements in the sample. Ages are obtained as the ratio of total dose to annual dose, where the annual dose is assumed to have been similar in the past.

Palaeontology: The study of any fossilised remains or fossil traces of animals or plants which lived in the geological past and any site which contains such fossilised remains or traces.

Palaeosol: An ancient, buried soil formed on a palaeosurface. The soil composition may reflect a climate significantly different from the climate now prevalent in the area where the soil is found. Burial reflects the subsequent environmental change.

Palaeosurface: An ancient land surface, usually buried and marked by a palaeosol or pedocrete, but may be exhumed by erosion (*e.g*. wind erosion/deflation) or by bulk earth works.

Pedogenesis/pedogenic: The process of turning sediment into soil by chemical weathering and the activity of organisms (plants growing in it, burrowing animals such as worms, the addition of humus *etc.*).

Pedocrete: A duricrust formed by pedogenic processes.

PIA: Palaeontological Impact Assessment.

Rhizolith: Fossil root. Most commonly formed by pedogenic carbonate deposition around the root and developed in palaeosols.

Sepiocrete: A duricrust with a high content of the magnesian clay mineral sepiolite.

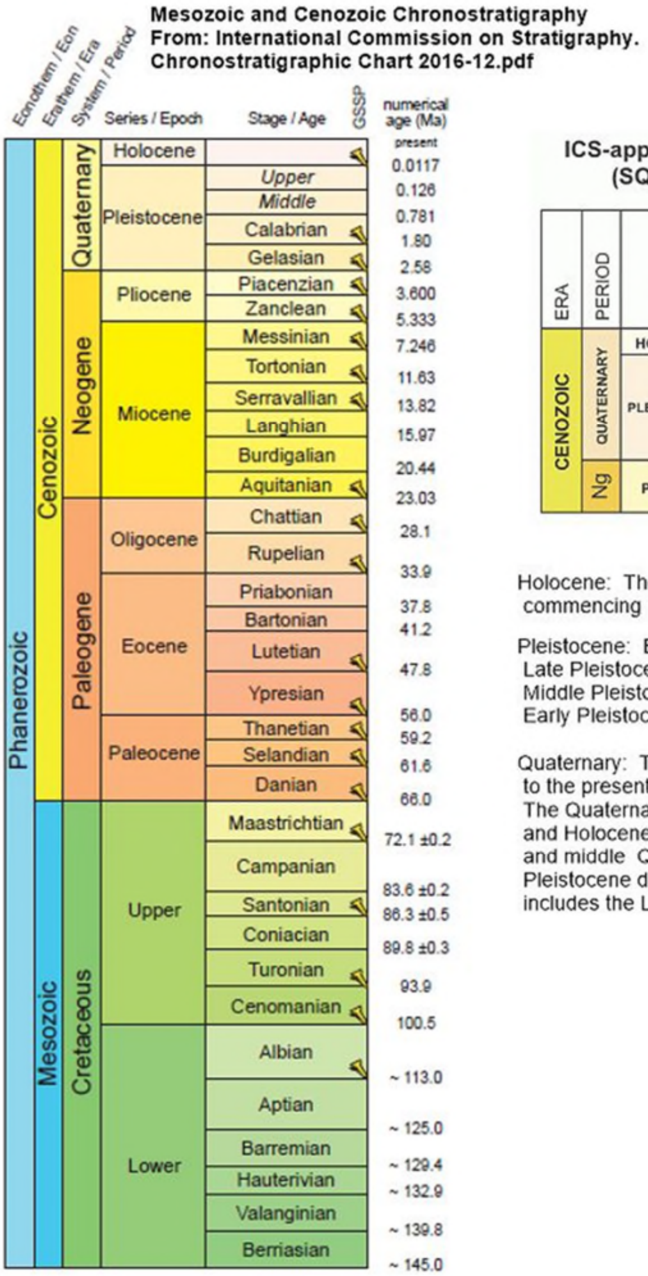
Stone Age: The earliest technological period in human culture when tools were made of stone, wood, bone or horn.

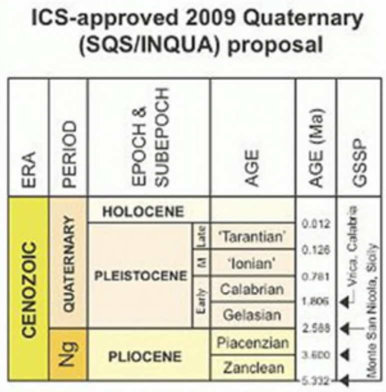
Stratotype locality: The place where deposits regarded as defining the characteristics of a particular geological formation occur.

Tectonic: Relating to the structure of the earth's crust and the large-scale processes which take place within it (faulting and earthquakes, crustal uplift or subsidence.

Trace fossil: A structure or impression in sediments that preserves the behaviour of an organism, such as burrows, borings and nests, feeding traces (sediment processing), farming structures for bacteria and fungi, locomotion burrows and trackways and traces of predation on hard parts (tooth marks on bones, borings into shells by predatory gastropods and octopuses).

GEOLOGICAL TIME SCALE TERMS





Holocene: The most recent geological epoch commencing 11.7 ka till the present.

Pleistocene: Epoch from 2.6 Ma to 11.7 ka.
Late Pleistocene 11.7–126 ka.
Middle Pleistocene 135–781 ka.
Early Pleistocene 781–2588 ka.

Quaternary: The current Period, from 2.6 Ma to the present, in the Cenozoic Era. The Quaternary includes both the Pleistocene and Holocene epochs. As used herein, early and middle Quaternary correspond with the Pleistocene divisions, but late Quaternary includes the Late Pleistocene and the Holocene.

ka: Thousand years or kilo-annum (10^3 years). Implicitly means "ka ago" *i.e*. duration from the present, but "ago" is omitted. The "Present" refers to 1950 AD. Not used for durations not extending from the Present. For a duration only "kyr" is used.

Ma: Millions years, mega-annum (10^6 years). Implicitly means "Ma ago" *i.e.* duration from the present, but "ago" is omitted. The "Present" refers to 1950 AD. Not used for durations not extending from the Present. For a duration only "Myr" is used.

For more detail see www.stratigraphy.org.

1 INTRODUCTION

Genesis Namas Wind (Pty) Ltd and Genesis Zonnequa Wind (Pty) Ltd propose to develop two adjacent Wind Energy Facilities (Wind Farms) on the coastal plain of Namaqualand in the Northern Cape, the names being the Namas Wind Farm and the Zonnequa Wind Farm respectively. ASHA Consulting (Pty) Ltd. has been appointed to carry out a Heritage Impact Assessment (HIA) for the proposed Wind Farms, of which this Palaeontological Impact Assessment report forms part. Its brief is to inform the developers of any palaeontological sensitivities within the proposed project sites, and the probability of fossils being uncovered in the subsurface and being disturbed or destroyed in the process of construction. This study has been undertaken from a desktop level and is considered to be sufficient for the area under assessment.

2 LOCATION

The proposed Wind Farms are located about 20 km southeast of Kleinsee in the Nama Khoi Local Municipality, Namakwa District Municipality, Northern Cape Province (Figure 1). The properties involved are listed below, as well as the properties traversed by the corridor for the power lines:

Namas Wind Farm	Power line (from south to north)
Portion 3 of Farm Rooivlei 327 Remainder of farm Rooivlei 327 Portion 3 of Farm Zonnekwa 328 Portion 4 of Farm Zonnekwa 328	Remainder of Farm Rooivlei 327 Portion 3 of Farm Zonnekwa 328 Portion 2 of Farm Zonnekwa 328 Portion 1 of Farm Zonnekwa 326 Remainder of Farm Zonnekwa 326 Remainder of Kannabieduin 324 Remainder of Sand Kop 322 Remainder of Farm Mannels Vley 321 Remainder of Farm Dikgat 195 Remainder of Farm Honde Vlei 325 Portion 15 of Farm Dikgat 195

Zonnequa Wind Farm	Power line (from south to north)
Remainder of farm Zonnekwa 326 Portion 1 of Farm Zonnekwa 328	Remainder of Farm Zonnekwa 326 Remainder of Kannabieduin 324 Remainder of Sand Kop 322 Remainder of Farm Mannels Vley 321 Remainder of Farm Dikgat 195 Remainder of Farm Honde Vlei 325 Portion 15 of Farm Dikgat 195

The relevant 1:50000 topo-cadastral maps are 2917CC BRAZIL and 2917CD KOMAGGAS for the proposed Wind Farms and 2916DB & 2917CA KLEINSEE for the power lines.

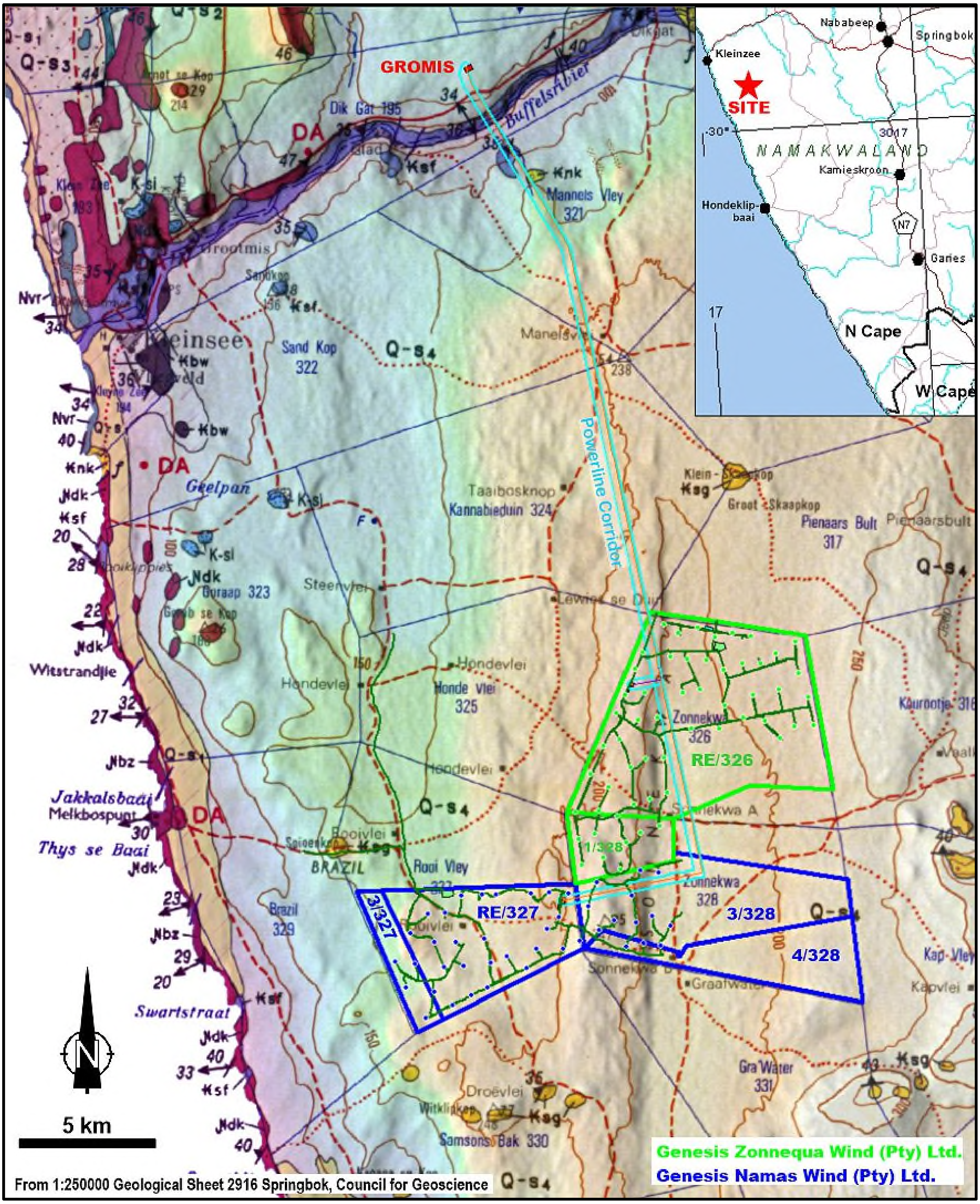


Figure 1: Location and Geology of the Project Area. Geological map with background shaded relief. Most of the coastal plain is covered by aeolian sands labelled as Q-s_4.

3 LOCALITY PLAN

The proposed layouts of the wind turbines are shown in Figure 2 in which the surficial aeolian formations are annotated.

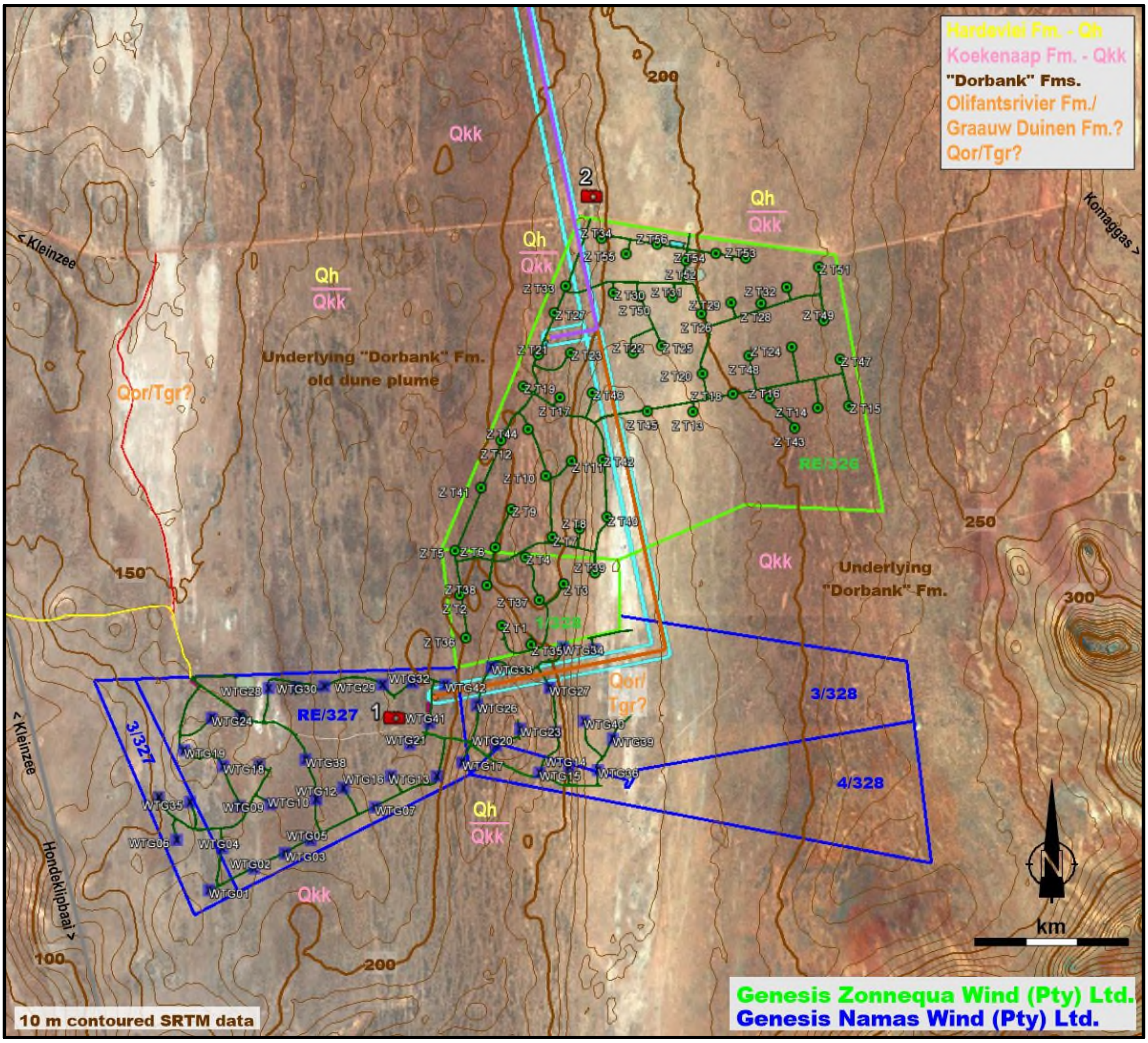


Figure 2: The proposed turbine layouts. Location of Figure 4 = 1; Figure 5 = 2. Due to the generalised nature of this report, the details of the turbines layouts do not substantially influence its findings.

4 PROPOSED DEVELOPMENT

The proposed Namas Wind Farm involves up to 43 wind turbines, and up to 56 turbines are envisaged for the Zonnequa Wind Farm (Figure 2). Concomitant infrastructure entails access roads, construction laydown areas, cabling trenches, control stations, workshop and offices. The power lines to the ESKOM grid are intended to proceed along the existing

ESKOM Gromis-Juno corridor to the Gromis substation (Figure 1) (the 400kV Gromis-Juno power line has been authorised and will be constructed within the near future). The power lines for the wind farms are assessed as 300m power line corridors. Each facility will have its own power line to connect to the grid.

5 PALAEONTOLOGICAL HERITAGE RESOURCES IDENTIFIED

5.1 Regional Geological History

The Project Area extends across the sandy coastal plain between elevations of ~150-230 m asl. A sense of the underlying bedrock topography in the wider area is imparted by outcrops on gentle eminences and hills. These are quartzites of the **Springbok Formation** (Bushmanland Group, Khurisberg Subgroup) (Figure 1, Ksg), which are altered, very ancient sediments approximately 1600 Ma (Ma = million years old) (Marais *et al*., 2001). There are no fossils in these rocks.

At times during the late Cretaceous and Palaeogene periods this higher part of the coastal plain was occupied by the sea during times of global warming, polar icecap melting and high sea levels, but marine deposits from these times have evidently been eroded away, or remain as undiscovered residual patches beneath the thick cover. The earlier/lower deposits now comprise colluvial and alluvial deposits in places, which are succeeded mainly by aeolian (windblown) sands. These older aeolian deposits infilling the broad areas of lower bedrock topography are made up of distinct formations of rapidly accumulated sands, separated by developed soils and pedocretes, such as calcretes, which represent periods of landscape surface stability. Our knowledge of these older aeolianite formations comes from the huge mine pits created by diamond and heavy-mineral mining, but these observations are confined to the lower coastal plain (<~100 m asl.) where marine deposits underlie and are interbedded with the aeolian formations. The major pedocretes present in the mining pits are regional in extent and will occur within the unexposed and unknown aeolian sequences of the higher coastal plain.

The area of aeolian sands labelled as Q-s_4 (Figure 1) may be elaborated by extrapolating some of the formations recognised farther south (De Beer (2010) and pers. obs.). The older aeolian formations, such as the **Olifantsrivier** and **Graauw Duinen** formations (Table 1), which are exposed in mine pits and eroding cliffs close to the coast, are rarely exposed on the higher coastal plain inland from ~100 m asl., except as outcrops of their cappings of well-developed pale pedocretes (calcrete, sepiocrete) in places. For the most part these older formations are buried beneath more aeolianites of varying ages and thicknesses which have been transformed by pedogenesis into yellow-brown to red-brown, semi-cemented beds colloquially called "dorbank". Overlying the hard surfaces on the tops of these "**Dorbank formations**" are the poorly-consolidated to loose, surficial sandsheets and dunes of the modern landscape. In the area of interest these are the **Koekenaap** and **Hardevlei** formations (Table 1) (Figures 2 & 3).

The more recent aeolian history is expressed in features of the topography, dune morphologies, sand colours and vegetation patterns. The distribution of the surficial sand formations in the wider area (Figure 3) shows the roles of the river beds and the beaches as sand sources for southerly wind. The white sands of the Swartlintjies dune plume (Figure 3, **Swartlintjies Formation**., Qsw) are the latest large-volume additions to the coastal plain. The plume morphology suggests that the sands were blown by south winds from the beaches now submerged by rising sea levels since the Last Ice Age maximum ~20 ka (ka = thousand years ago) (Figure 4, LGM), when the shoreline was ~120 m below present (Tankard & Rogers, 1978). Similarly, dune plumes blew inland from the coast in the past.

TABLE 1. NAMAQUALAND COASTAL STRATIGRAPHY

Formation Name	Deposit type	Age
Witzand	Aeolian pale dunes & sandsheets.	Holocene, <~12 ka.
Curlew Strand, Holocene High	**Marine, 2-3 m Package.**	**Holocene, 7-4 ka.**
Swartlintjies & Swartduine	Aeolian dune plumes.	Latest Quat., <20 ka.
Hardevlei	Aeolian, semi-active surficial dunes, >100 m asl.	Latest Quat., <25 ka.
Koekenaap	Aeolian, surficial red aeolian sands.	later late Quat., 80-30 ka.
Unnamed coastal fms.	Aeolianites, limited pedogenesis, weak pedocrete	earlier late Quat., 125-80 ka.
Curlew Strand, MIS 5e, LIG.	**Marine, 4-6 m Package.**	**earliest late Quat., ~125 ka.**
Fossil Heuweltjiesveld palaeosurface on Olifantsrivier & Dorbank fms.		
Unnamed "Dorbank" fms.	Aeolian, reddened, semi-lithified.	later mid-Quat., ~400-140 ka.
Curlew Strand, MIS 11	**Marine, 8-12 m Package.**	**mid Quat., ~400 ka.**
Olifantsrivier	Aeolianite, colluvia, pedocrete.	early-mid Quat., ~2-0.4 Ma.
Graauw Duinen Member 2	Aeolianite, colluvia, pedocrete.	latest Plio-early Quat.
Hondeklipbaai	**Marine, 30 m Package, LPWP.**	**late Pliocene, ~3 Ma.**
Graauw Duinen Member 1	Aeolianite, colluvia, pedocrete.	mid Pliocene.
Avontuur	**Marine, 50 m Package, EPWP.**	**early Pliocene, ~5 Ma.**
Unnamed	Aeolianites, weathered.	later Miocene (14-5 Ma)
Kleinzee	**Marine, 90 m Package, MMCO.**	**mid Miocene, ~16 Ma.**
MMCO – Mid Miocene Climatic Optimum. EPWP – Early Pliocene Warm Period. LPWP – Late Pliocene Warm Period.		

The variously-reddened, unconsolidated coversands and low, degraded dunes which mantle most of the surface of the coastal plain have been named the **Koekenaap Formation** (Roberts *et al.*, 2006; De Beer, 2010). Preliminary results of Optically-Stimulated-Luminescence (OSL) dating of some reddened coversands (Chase & Thomas, 2006, 2007) produced late Quaternary ages between ~80 ka and ~30 ka (Figure 4) and suggest phases of accumulation which differ between areas. Sand sources include the coast and reworking of older sands, while the older red sands on the higher, inner coastal plain have apparently been sourced from the local rivers.

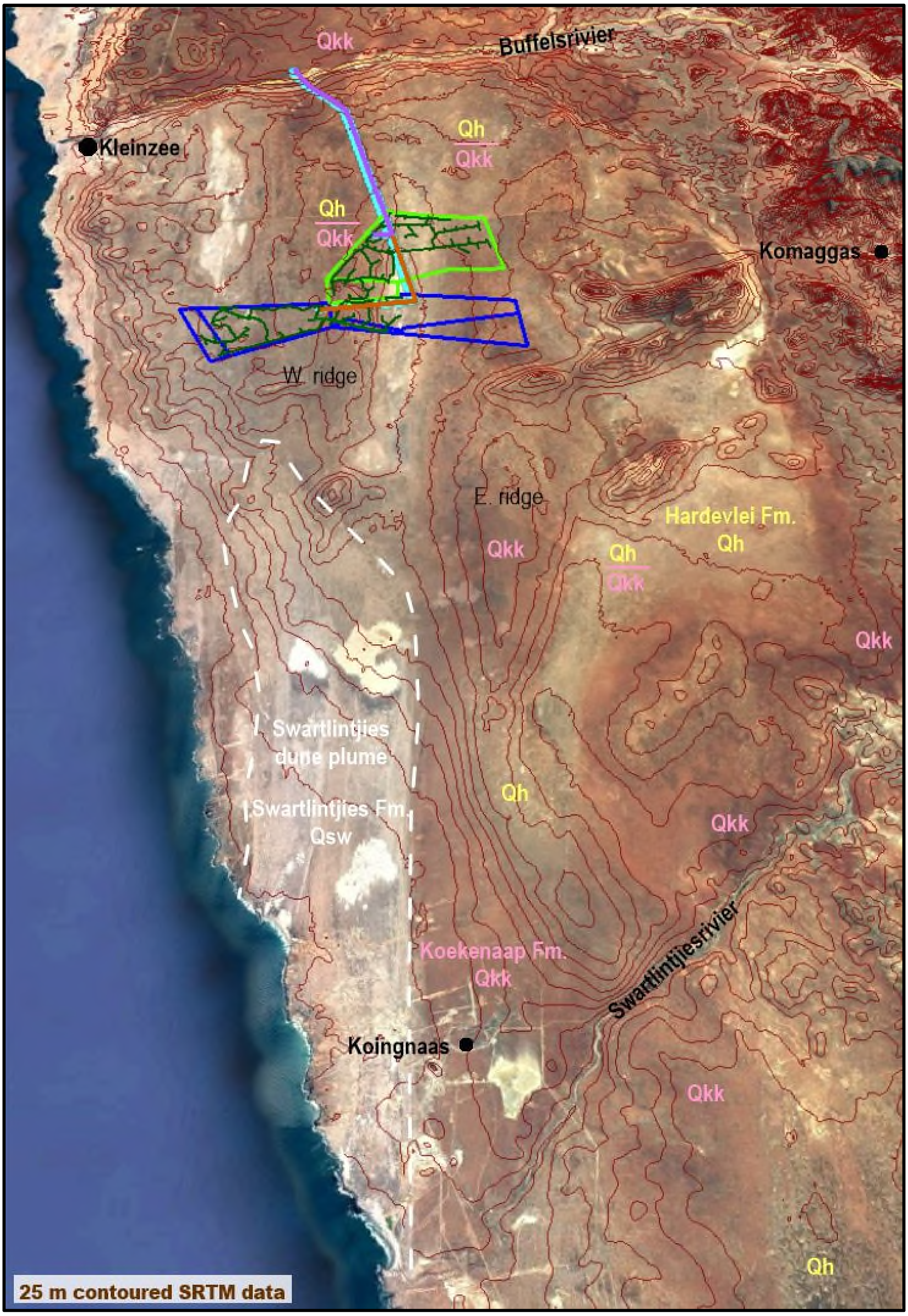


Figure 3: Overview of surficial sand formations in the Swartlintjies-Buffels aeolian compartment. Simulated oblique aerial view from Google Earth.

A feature of these older coversands is the development of a patterned vegetation of clumped shrubs which, with ongoing sand movement and ecological feedbacks, evolve into "heuweltjiesveld", a terrain of approximately evenly-spaced low mounds of more fertile sandy soil which are the foci of the biological processes in the coversand ecology. They are inhabited by termites and fossorial animals and burrowed into by aardvarks, meerkats and porcupines. With time, more evolved soils and calcrete lenses form within the maturing heuweltjies, indicative of the relative age of the coversand surface in an area. A "fossil" heuweltjiesveld palaeosurface, buried beneath the current Koekenaap coversands heuweltjiesveld, is seen in southern Namaqualand where the coversands have been removed by mining, exposing the circular calcrete lenses of a former heuweltjiesveld terrain that had formed in the top of the Dorbank Formation there.

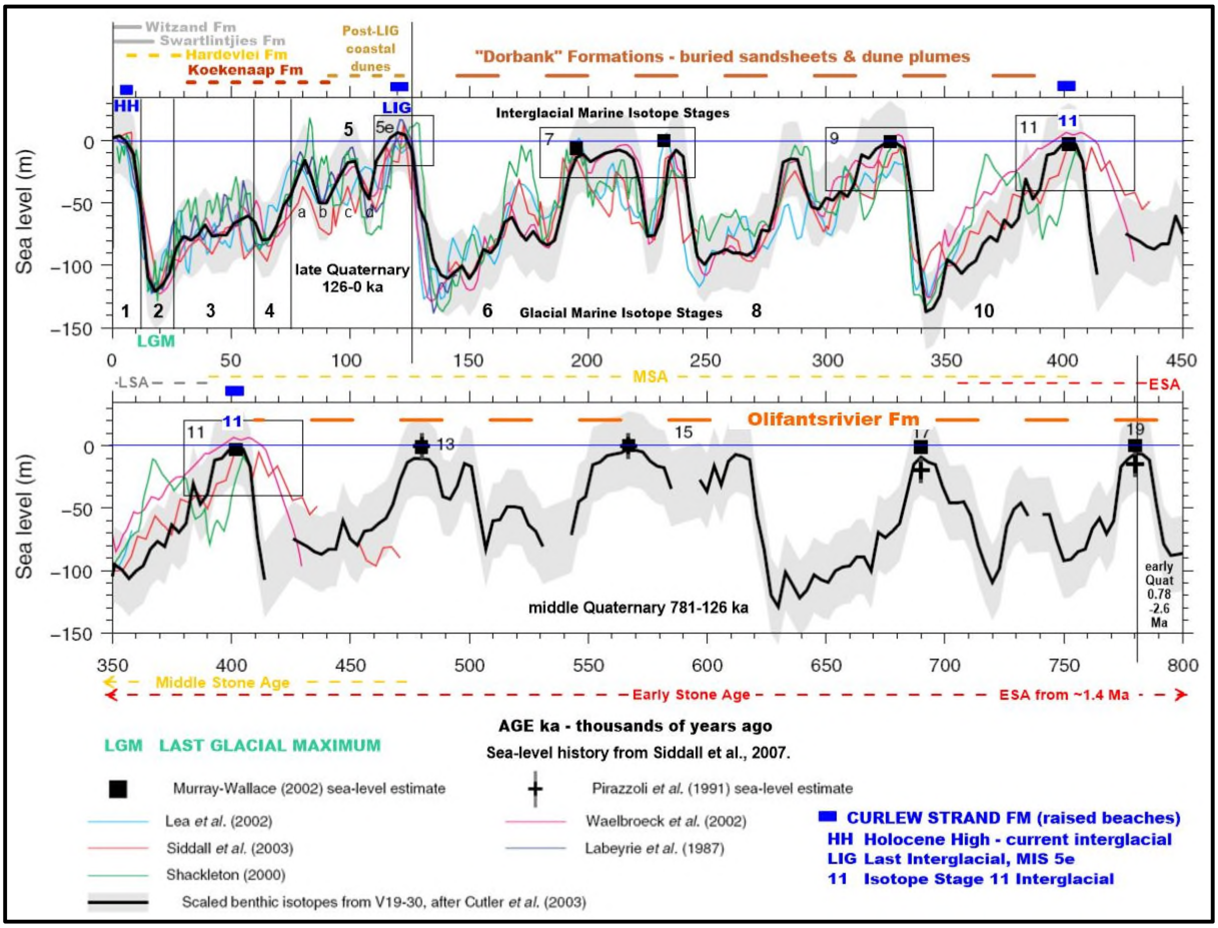


Figure 4: Sea-level history and the age ranges of middle and late Quaternary formations of the Namaqualand coastal plain.

At the coast the Koekenaap Fm. is overlain by the pale sands of the Swartlintjies and **Witzand** formations, the latter being smaller, active dune fields linked to local, modern beach sand sources. Farther inland, the latest aeolian activity is manifest in the yellow dunes of the **Hardevlei Formation** (Garies Sheet, De Beer, 2010) which encompasses fields of low, pale-yellow dunes of varied morphology overlying the Koekenaap-type sands or the local Dorbank Fm. Dune types include both parallel, longitudinal sand ridges formed by the northward migration of vegetation-impeded, parabolic, "hairpin" dunes, and transverse, barchanoid (crescentic) dunes. In southern Namaqualand both morphologies are combined to form reticulate dune fields. Dating by the OSL technique indicates ages generally less than ~25 ka (Chase & Thomas, 2006, 2007) (Figure 4).

5.2 Local Geological History

Notable large-scale topographic features of the Project Area (Figures 1, 2 & 3) are the red-brown ridge along the western parts of Zonnekwa 326 and Zonnekwa 328 and the eastern part of Rooivlei RE/327, the accompanying low-lying, pale-hued shallow valley forming its eastern flank and the red-brown deposits occupying the rising slope farther to the east (Figure 3). The western ridge is an aeolian depositional feature, the valley is a non-depositional zone and the slope farther east is underlain by the extension of another, older depositional aeolian ridge which stretches all the way from the lower reach of the Swartlintjiesrivier (Figure 3).

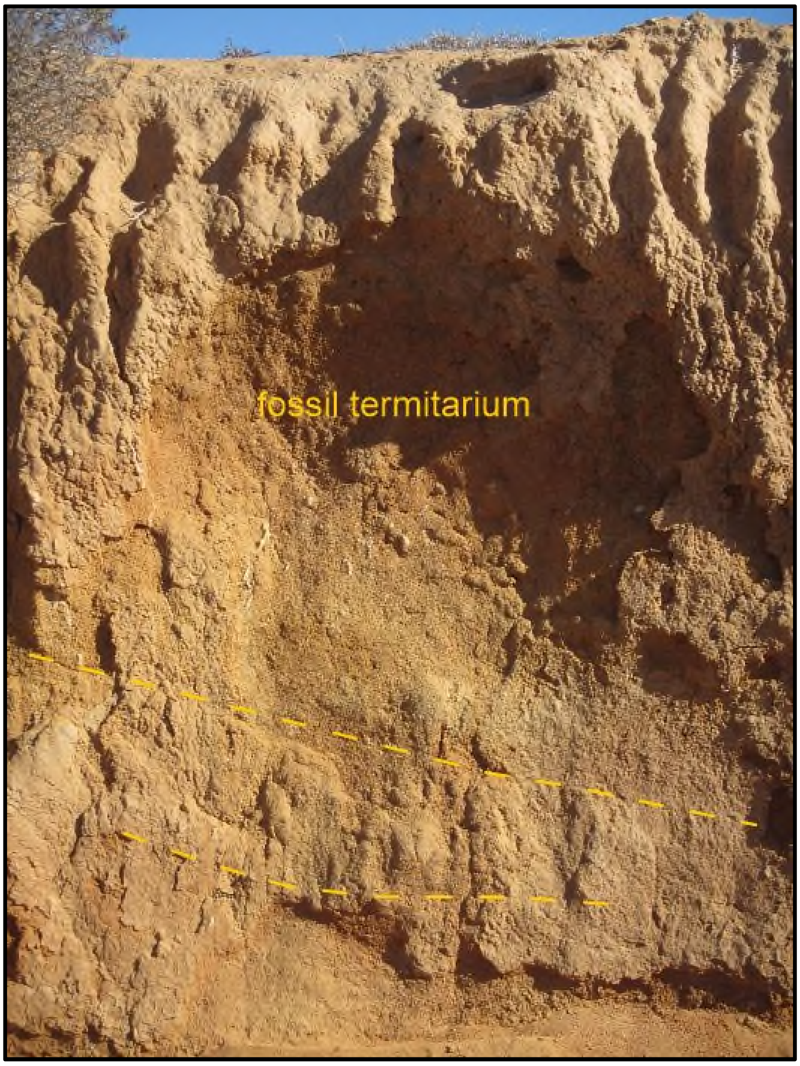


Figure 5: The uppermost Dorbank Fm. unit at location 1 in Fig. 2. Dashed lines trace relict dune lower-foreset crossbedding lapping tangentially onto basal wind-ripple laminated interval. Image courtesy of J. Orton.

The central valley is apparently closely underlain by a pale pedocrete beneath which the older formations are expected, equivalent to the **Olifantsrivier** or **Graauw Duinen** formations (Table 1; Figure 2, Qor/Tgr?).

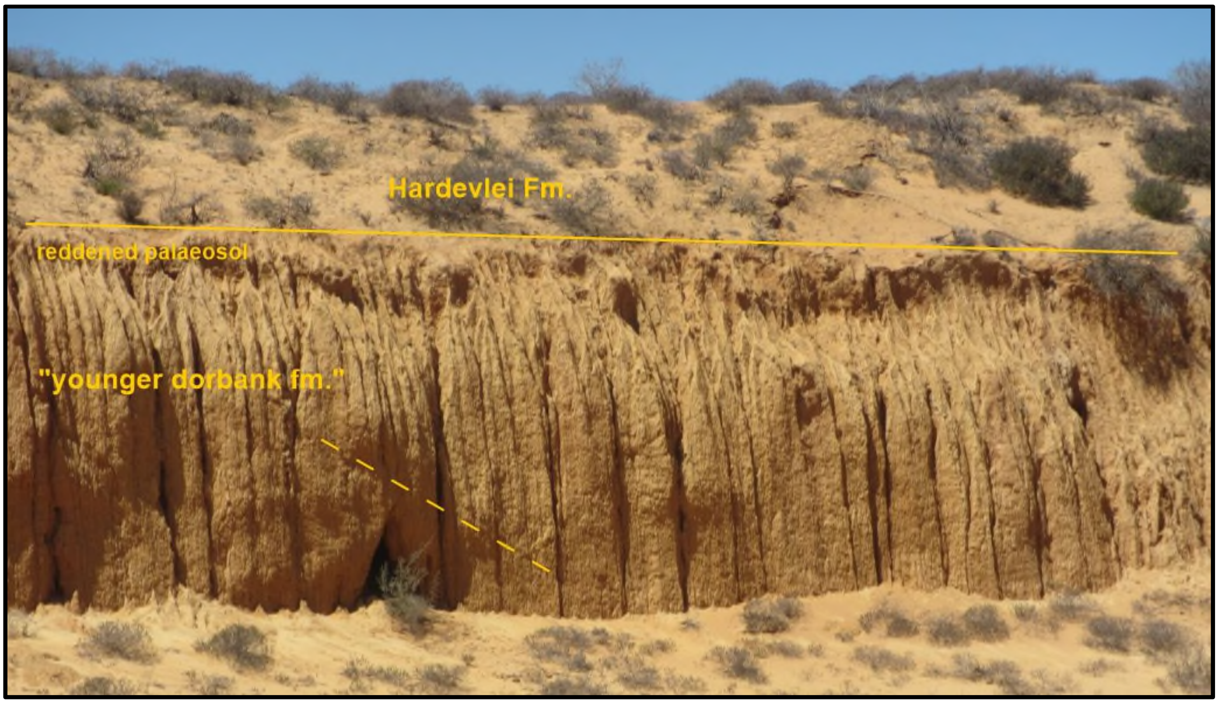


Figure 6: The Dorbank Unit at location 2 in Fig. 2. Dashed line indicates relict, steep aeolian foreset crossbedding. Unconsolidated dune sand of the Hardevlei Formation overlies a thin palaeosol. Image courtesy of J. Orton.

A shallow pit in the western ridge flank (Figure 2, location 1) shows the aeolian unit at the top of the compact Dorbank Formation (Figure 5). Another pit in the opposite flank (Figure 2, location 2) shows a similar unit with steep dune crossbedding (Figure 6), considered to be the same formation exposed at location 1. The formation has been subjected to pedogenesis, with the formation of neoformed interstitial clay, but the lack of a developed pedocrete and pedogenic segregations/mottles, and the relatively soft, eroding exposures, indicate that the unit is a relatively young Dorbank formation. The western ridge pre-dates the poorly-consolidated to loose coversands and dunes and is considered to be of later mid-Quaternary age (Figure 4). For instance, at the youngest it is of Marine Isotope Stage (MIS) 6 to MIS 5/6 age. It is on trend with the Swartlintjies dune plume and appears to be an earlier plume that extended considerably farther north (Figure 3). The eastern ridge is assumed to be an older, fossil dune-plume Dorbank formation.

On top of the Dorbank formations are red coversands of the **Koekenaap Formation** and overlying yellow dunes of the **Hardevlei Formation** (Figure 2). The former is exposed in the interdune "streets" which exhibit the clumped vegetation pattern typical of heuweltjiesveld formed on older coversands. The Koekenaap-type coversand is evidently quite thin and may be effectively absent in areas (*e.g*. Figure 6), with the clumped vegetation rooted in the soil on the Dorbank formations.

The Hardevlei Formation dunes are primarily in the form of longitudinal sand ridges (Figure 2), with a spacing of about 100 m and a "fine-grained" vegetation texture. The sand ridges are the trailing arms of parabolic or "hairpin" dunes which typically form when sand transport is partly impeded by vegetation growth. The Hardevlei Fm. dunes formed since ~25 ka, but the older OSL ages occur mainly in southern Namaqualand. The dates from four localities north of the Swartlintjiesrivier indicate that the Hardevlei dunes there have formed during the early to mid-Holocene, from ~12 to ~4 ka, partly contemporaneous with the Swartlintjies Fm. dune plume to the south (Figure 6). It seems the source for the Hardevlei Fm. dunes on the western ridge is sand blowing farther north from the Swartlintjies dune plume, as well as sand reworked from the older coversand and dorbank in erosional areas downwind. On the eastern Zonnekwa slopes the Hardevlei dunes appear to have mainly formed by reworking of the underlying coversands.

The power line corridor traverses across Hardevlei Fm. dune terrain until approaching the Buffelsrivier where there is a dark reddish patch (Figure 3) surrounding a slight hill with outcropping bedrock. The slopes are mantled by old, reddened colluvia that have been lithified to hard pedocrete. The dark red heuweltjiesveld which occurs in the general area is evidently a patch of older Koekenaap Fm. coversands thinly covering the bedrock.

Dark red-brown surficial cover attributable to the Koekenaap Fm. dominates immediately north of the Buffelsrivier (Figure 3). Here 7 metres of red sand accumulated between ~70 to ~20 ka (Site WC03-10, Chase & Thomas, 2007). This illustrates the role of the river as an aeolian compartment boundary, supplying sand for northward transport and impeding sand encroachment from the south by its periodic removal.

6 ANTICIPATED IMPACTS

The fossil bones that have been found hitherto in the aeolianites of Namaqualand attest to the fossil potential that will be delivered by the continuation of systematic searches for these sparse remains. Fossil material most commonly seen is the ambient fossil content of dune sands: land snails, tortoise shells and mole bones. Other small bones occur very sparsely such as bird and small mammal bones. The fossil content is more abundant in association with palaeosurfaces and their soils (palaeosols), formed during periods of dune stabilisation and which define aeolian packages and larger formations. Importantly, the bones of larger animals (*e.g.* antelopes) are more persistently present along palaeosurfaces which separate the major aeolianite units. Large caches of bones have been found in aardvark burrows that were subsequently occupied by hyaenas.

Although fossil bones are very sparse in aeolian Dorbank formations and overlying coversands and dunes, they are of high scientific value and important for palaeoclimatic, palaeobiological and biostratigraphic studies. The fossil material in these deposits is a sample of the middle and late Quaternary fauna of the Namaqualand coast. For example, fossil bones in aeolianite near the Swartlintjiesrivier were associated with Early Stone Age artefacts and include large species (elephant, sivathere, zebra). *Sivatherium maurusium* was a large, heavily-built short-necked giraffid common in Africa between ~5.0 to ~0.4 Ma. In addition small species were collected (hare, squirrel, moles, snakes). The estimated age is mid-Quaternary and the large mammals indicate that the coast was better watered than the present-day (Pickford & Senut, 1997).

A late Quaternary fauna was obtained from calcareous interdune deposits exposed between the dunes of the Swartlintjies Formation. The presence of frogs indicates a damp environment. Larger species include ostrich, zebra and steenbok and oddly, giraffe, a tree browser. A variety of small rodent taxa occurred. Other than the giraffe, the fauna is essentially modern. The giraffe suggests that woodland still occurred in Namaqualand as recently as the late Quaternary, probably related to riverine settings and wetter conditions associated with ice age climate (Pickford & Senut, 1997), or wet spells during the deglaciation.

The dimensions of the wind turbine foundation slabs are 20 X 20 X 3 m. There will be a considerable number of them (~99) distributed over and "sampling" a wide area. Therefore, in spite of the overall low fossil potential, there is a distinct possibility that fossil bones may be exposed in some of the excavations. The top of the Dorbank formations will be intersected, on which fossil bones and Stone Age archaeological material occur, as is quite commonly observed where the unconsolidated sands have been blown away, exposing the surface. This material will include objects that were in the coversands, as well as bones and artefacts originally deposited on the Dorbank Unit surface. Where the Dorbank Unit is thinner along the edges of the depositional ridges, the underlying, potentially-fossiliferous palaeosurface and pedocrete on top of an older formation will be intersected. The valley between the depositional ridges may have hosted pans or waterholes during wetter periods in the past, with considerably greater fossil potential.

The excavations for cabling and other infrastructure are shallow and mainly affect the coversands, but the cabling trenches will traverse considerable lengths across the Project Area and intersect the top of the Dorbank Unit in places. The footings of the transmission line pylons that connect to the grid are likely to be minor in scale and have a low likelihood of fossil finds, although not altogether absent.

7 IMPACT ASSESSMENT – CONSTRUCTION PHASE

7.1 Nature of the Impact of Bulk Earth Works on Fossils

Fossils are rare objects, often preserved due to unusual circumstances. This is particularly applicable to vertebrate fossils (bones), which tend to be sporadically preserved and have high value with respect to palaeoecological and biostratigraphic (dating) information. Such fossils are non-renewable resources. Provided that no subsurface disturbance occurs, the fossils remain sequestered there.

Overall the palaeontological sensitivity of coastal deposits is HIGH (Almond & Pether, 2009) due to previous fossil finds of high scientific importance. When excavations are made they furnish the "windows" into the coastal plain depository that would not otherwise exist and thereby provide access to the hidden fossils. The impact is positive for palaeontology, provided that efforts are made to watch out for and rescue the fossils. Fossils and significant observations will be lost in the absence of management actions to mitigate such loss. This loss of the opportunity to recover them and their contexts when exposed at a particular site is irreversible. The status of the potential impact for palaeontology is not neutral or negligible. The very scarcity of fossils makes for the added importance of looking out for them.

There remains a medium to high risk of valuable fossils being lost in spite of management actions to mitigate such loss. Machinery involved in excavation may damage or destroy fossils, or they may be hidden in "spoil" of excavated material.

7.2 Extents

The physical extent of impacts on potential palaeontological resources relates directly to the extents of subsurface disturbance involved in the installation of infrastructure during the Construction Phase, *i.e.* LOCAL.

However, unlike an impact that has a defined spatial extent (*e.g.* loss of a portion of a habitat), the cultural, heritage and scientific impacts are of regional to national extent, as is implicit in the National Heritage Resources Act No. 25 (1999) and, if scientifically important specimens or assemblages are uncovered, are of international interest. This is evident in the amount of foreign-funded palaeontological research that takes place in South Africa by scientists of other nationalities. Loss of opportunities that may arise from a significant fossil occurrence (tourism, employment) filters down to regional/local levels.

7.3 Duration

The initial duration of the impact is shorter term (<5 years) and primarily related to the Construction Phase when excavations for infrastructure are made. This is the "time window" for mitigation.

The impact of both the finding or the loss of fossils is permanent. The found fossils must be preserved "for posterity"; the lost, overlooked or destroyed fossils are lost to posterity. The duration of impact is therefore PERMANENT with or without mitigation.

7.4 Intensity

The intensity or magnitude of impact relates to the palaeontological sensitivities of the formations (Appendix 1). Due to the overall sparse distribution of fossil bones in the affected formations the sensitivity is considered to be LOW.

7.5 Probability

In consideration of the scale of subsurface disturbance it is PROBABLE that fossil bones will be unearthed.

7.6 Impact Significance Rating

This impact assessment, according to the scheme in Appendix 2, does not differentiate between formations as the palaeontological sensitivities of the affected formations with respect to the occurrence of fossil bones are all low.

Nature: Direct destruction of or damage to fossil bones or resources through excavation of foundations and trenches in all aeolian formations.		
	Without mitigation	**With mitigation**
Extent	Study area (2)	Study area (2). If important fossil find becomes regional-international (3-5)
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (4)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	**33 (Medium)**	**33 (Medium)**
Status (positive or negative)	Negative	Positive
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Yes	Partly
Can impacts be mitigated?	Yes, but only partial mitigation is possible. Valuable fossils may be lost in spite of management actions to mitigate such loss.	
Mitigation: » Monitoring of all construction-phase excavations by project staff and ECO. » Inspection, sampling and recording of selected exposures in the event of fossil finds. » Fossil finds and the compiled contextual report deposited in a curatorial scientific institution.		
Residual Impacts: It will never be possible to spot and rescue all fossils which means that there will always be some loss and therefore residual impact. This would be of unknown significance because of the sparse distribution of fossils in the broader landscape. Positive impacts would continue to be felt with successful mitigation because of the scientific implications of the resulting research opportunities		

8 RECOMMENDATIONS

The Medium/moderate level of significance indicates that the palaeontological impact does not greatly influence the decision to develop the area, but appropriate mitigation measures are required. Therefore, the development of the wind farms within the project sites is considered to be acceptable from a palaeontological perspective and can be authorised, subject to the implementation of the recommended mitigation measures.

If palaeontological mitigation is applied to these projects as recommended, it is possible that these developments will to some extent alleviate the negative cumulative impact on paleontological resources in the region.

The history of these vast tracts of sands, gravels and pedocretes of the Northern Cape is very poorly known, with very few fossils to rely on. Therefore, though of low probability, any find will be of considerable importance and could add to the scientific knowledge of the area in a positive manner.

8.1 Monitoring

In view of the low fossil potential, monitoring of bulk earth works by a specialist is not justified. Notwithstanding, the sporadic fossil occurrences are then particularly important and efforts made to spot them are often rewarded. Buried archaeological material may also be encountered. It is recommended that a requirement to be alert for possible fossils and buried archaeological material be included in the EMPr for the Construction Phase of the proposed Namas and Zonnequa Wind Farms and power lines, with a Fossil Finds Procedure in place.

The field supervisor/foreman and workers involved in digging excavations must be informed of the need to look out for fossils and buried potential archaeological material. Workers seeing potential objects are to cease work at that spot and to report to the field supervisor who, in turn, will report to the Environmental Control Officer (ECO). The ECO will inform the developer and contact the palaeontologist contracted to be on standby in the case of fossil finds. The latter will liaise with SAHRA on the nature of the find and consequent actions (permitting and collection of find).

The Fossil Finds Procedure included as Appendix 3 provides guidelines to be followed in the event of fossil finds. Only a professional palaeontologist may excavate uncovered fossils with a valid mitigation permit from SAHRA.

8.2 Basic Measures for the Construction Phase EMPr

The following measures apply to all earthworks affecting all formations discussed above.

OBJECTIVE: To see and rescue fossil material that may be exposed in the excavations made for installation of the wind farms.	
Project components	Turbine foundation excavations, trenches for cabling & infrastructure, powerline footings, spoil from excavations.
Potential impact	Loss of fossils by their being unnoticed and/ or destroyed.
Activity/ risk source	All bulk earthworks.
Mitigation: target/ objective	To facilitate the likelihood of noticing fossils and ensure appropriate actions in terms of the relevant legislation.

MITIGATION: ACTION/ CONTROL	**RESPONSIBILITY**	**TIMEFRAME**
Inform staff of the need to watch for potential fossil occurrences.	The Developer, the ECO and contractors.	Pre-construction.
Inform staff of the Fossil Finds Procedures to be followed in the event of fossil occurrences.	ECO/Specialist.	Pre-construction.
Monitor for the presence of fossils.	Contracted personnel and ECO.	Construction.
Liaise with palaeontologist on the nature of potential finds and appropriate actions.	ECO and Specialist, SAHRA.	Construction.
Obtain a permit from SAHRA for the fossil finds collection should resources be discovered.	Developer and Specialist.	Construction
Excavate main finds, inspect pits and record and sample excavations.	Specialist.	Construction.

Performance Indicator	• Reporting of and liaison about possible fossil finds. • Fossils noticed and rescued. • Scientific record of fossil contexts and temporary exposures in earthworks.
Monitoring	• Ensure staff are aware of fossils and the procedure to follow when found. • ECO to conduct inspections of open excavations whenever on site.

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10 APPENDIX 1 - PALAEONTOLOGICAL SENSITIVITY RATING

Palaeontological Sensitivity refers to the likelihood of finding significant fossils within a geologic unit.

VERY HIGH: Formations/sites known or likely to include vertebrate fossils pertinent to human ancestry and palaeoenvironments and which are of international significance.

HIGH: Assigned to geological formations known to contain palaeontological resources that include rare, well-preserved fossil materials important to on-going palaeoclimatic, palaeobiological and/or evolutionary studies. Fossils of land-dwelling vertebrates are typically considered significant. Such formations have the potential to produce, or have produced, vertebrate remains that are the particular research focus of palaeontologists and can represent important educational resources as well.

MODERATE: Formations known to contain palaeontological localities and that have yielded fossils that are common elsewhere, and/or that are stratigraphically long-ranging, would be assigned a moderate rating. This evaluation can also be applied to strata that have an unproven, but strong potential to yield fossil remains based on its stratigraphy and/or geomorphologic setting.

LOW: Formations that are relatively recent or that represent a high-energy subaerial depositional environment where fossils are unlikely to be preserved, or are judged unlikely to produce unique fossil remains. A low abundance of invertebrate fossil remains can occur, but the palaeontological sensitivity would remain low due to their being relatively common and their lack of potential to serve as significant scientific resources. However, when fossils are found in these formations, they are often very significant additions to our geologic understanding of the area. Other examples include decalcified marine deposits that preserve casts of shells and marine trace fossils, and fossil soils with terrestrial trace fossils and plant remains (burrows and root fossils)

MARGINAL: Formations that are composed either of volcaniclastic or metasedimentary rocks, but that nevertheless have a limited probability for producing fossils from certain contexts at localized outcrops. Volcaniclastic rock can contain organisms that were fossilized by being covered by ash, dust, mud, or other debris from volcanoes. Sedimentary rocks that have been metamorphosed by the heat and pressure of deep burial are called metasedimentary. If the meta sedimentary rocks had fossils within them, they may have survived the metamorphism and still be identifiable. However, since the probability of this occurring is limited, these formations are considered marginally sensitive.

NO POTENTIAL: Assigned to geologic formations that are composed entirely of volcanic or plutonic igneous rock, such as basalt or granite, and therefore do not have any potential for producing fossil remains. These formations have no palaeontological resource potential.

Adapted from Society of Vertebrate Paleontology. 1995. Assessment and Mitigation of Adverse Impacts to Nonrenewable Paleontologic Resources - Standard Guidelines. News Bulletin, Vol. 163, p. 22-27.

11 APPENDIX 2 - METHODOLOGY FOR IMPACT ASSESSMENT

EFFECT	**Extents/Spatial Scale**		**E**
	Localised	At localised scale and a few hectares in extent .	1
	Study area	The proposed site and its immediate environs.	2
	Regional	District and Provincial level.	3
	National	Country.	4
	International	Internationally.	5
	Duration/Temporal Scale		**D**
	Very short	Less than 1 year.	1
	Short term	Between 2 to 5 years.	2
	Medium term	Between 5 and 15 years.	3
	Long term	Exceeding 15 years and from a human perspective almost permanent.	4
	Permanent	Resulting in a permanent and lasting change.	5
	Magnitude/Intensity (Palaeontological Sensitivity)		**M**
	No potential	Formations entirely lacking fossils such as igneous rocks.	0
	Marginal	Limited probability for producing fossils from certain contexts at localized outcrops.	2
	Low	Depositional environment where fossils are unlikely to be preserved, or are judged unlikely to produce unique fossil remains.	4
	Medium	Strong potential to yield fossil remains based on stratigraphy and/or geomorphologic setting.	6
	High	Formations known to contain palaeontological resources that include rare, well-preserved fossil materials.	8
	Very high	Formations/sites known or likely to include vertebrate fossils pertinent to human ancestry and palaeoenvironments and which are of international significance.	10
PROBABILITY	**Probability/Likelihood**		**P**
	Very improbable	Probably will not happen.	1
	Improbable	Some possibility, but low likelihood.	2
	Probable	Distinct possibility of these impacts occurring.	3
	Highly probable	The impact is most likely to occur.	4
	Definite	The impact will definitely occur regardless of prevention measures.	5

SIGNIFICANCE = (E+D+M)P		
< 30	LOW	The impact would not have a direct influence on the decision to develop in the area
30-60	MEDIUM	The impact could influence the decision to develop in the area unless it is effectively mitigated
>60	HIGH	The impact must have an influence on the decision process to develop in the area

12 APPENDIX 3 - FOSSIL FIND PROCEDURE

Monitoring

A constant monitoring presence over the period during which excavations for developments are made, by either an archaeologist or palaeontologist, is generally not practical.

The field supervisor/foreman and workers involved in digging excavations must be encouraged and informed of the need to watch for potential fossil and buried archaeological material. Workers seeing potential objects are to report to the field supervisor who, in turn, will report to the ECO. The ECO will inform the archaeologist and/or palaeontologist contracted to be on standby in the case of fossil finds.

To this end, responsible persons must be designated. This will include hierarchically:

- The field supervisor/foreman, who is going to be most often in the field.
- The Environmental Control Officer (ECO) for the project.
- The Project Manager/Site Agent.

Response by personnel in the event of fossil finds

In the process of digging the excavations fossils may be spotted in the hole sides or bottom, or as they appear in excavated material on the spoil heap.

- Stop work at fossil find. The site foreman and ECO must be informed.
- Protect the find site from further disturbance and safeguard all fossil material in danger of being lost such as in the excavator bucket and scattered in the spoil heap.
- The ECO or site agent must immediately inform the South African Heritage Resources Agency (SAHRA) and/or the contracted standby palaeontologist of the find and provide via email the information about the find, as detailed below.
  - Date
  - Position of the excavation (GPS) and depth.
  - A description of the nature of the find.
  - Digital images of the excavation showing vertical sections (sides) and the position of the find showing its depth/location in the excavation.
  - A reference scale must be included in the images (tape measure, ranging rod, or object of recorded dimensions).
  - Close-up, detailed images of the find (with scale included).

The South African Heritage Resources Agency (SAHRA) and/or the contracted standby palaeontologist will assess the information and a suitable response will be established which will be reported to the developer and the ECO, such as whether rescue excavation or rescue collection by a palaeontologist is necessary or not.

The response time/scheduling of the rescue fieldwork is to be decided in consultation with developer/owner and the ECO. It will probably be feasible to “leapfrog” the find and proceed to the next excavation, or continue a trench excavation farther along, so that the work schedule and machine time is minimally disrupted. The strategy is to rescue the material as quickly as possible.

Application for a Permit to Collect Fossils

A permit from SAHRA is required to excavate fossils. The applicant should be the qualified specialist responsible for assessment, collection and reporting (palaeontologist). Should fossils be found that require rapid collecting, application for a palaeontological permit must be made to SAHRA immediately. All fossils must be deposited at a SAHRA-approved institution.

In addition to the information and images of the find, the application requires details of the registered owners of the sites, their permission and a site-plan map.

APPENDIX 3: MAPPING

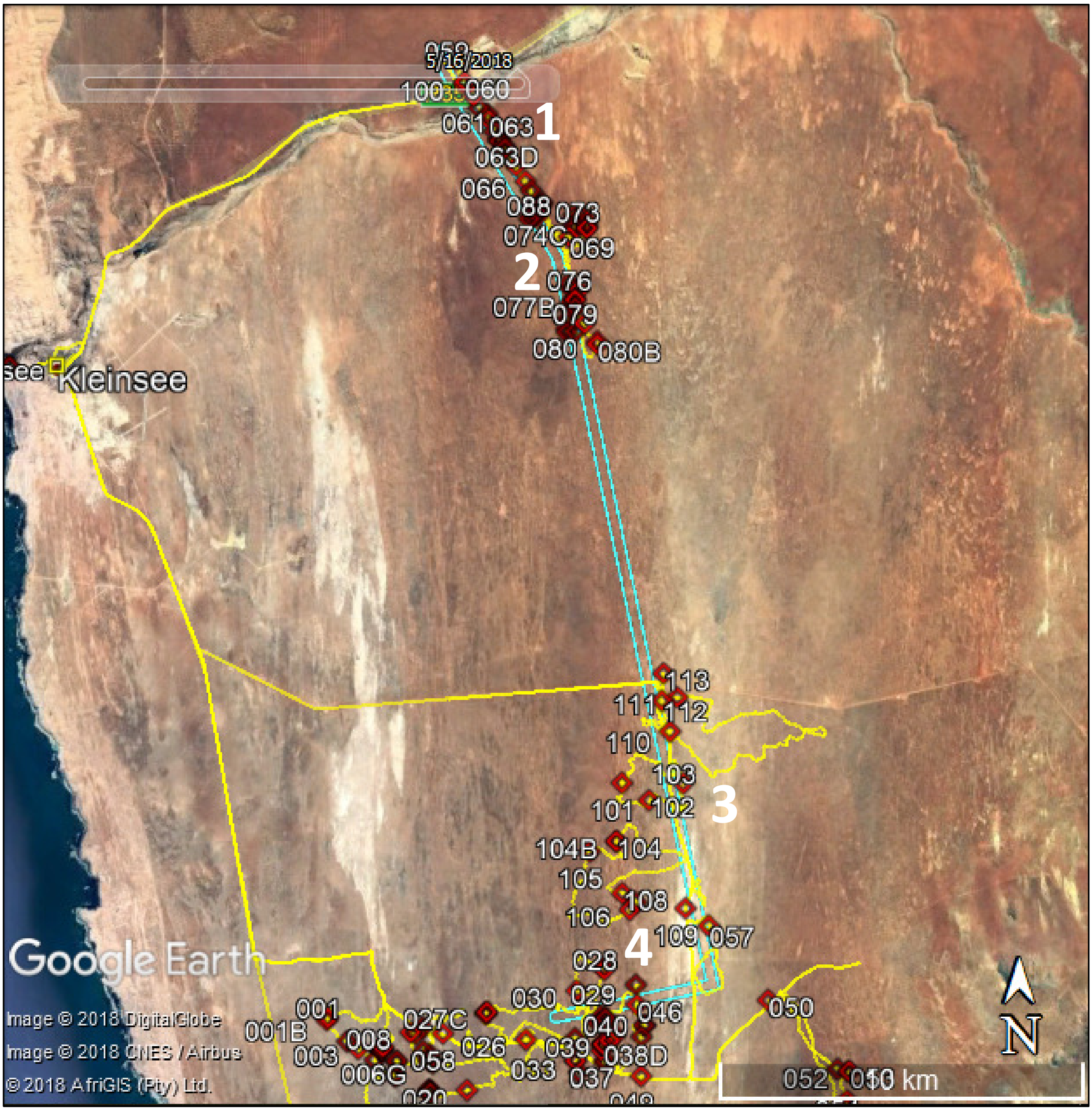


Figure A3.1: *Map of the 300m corridor (turquoise) showing the survey tracks (yellow lines) and archaeological finds (numbered red symbols). The area that could not be accessed is evident in the centre. The large white numbers indicate the close-up views in the Figures that follow.*

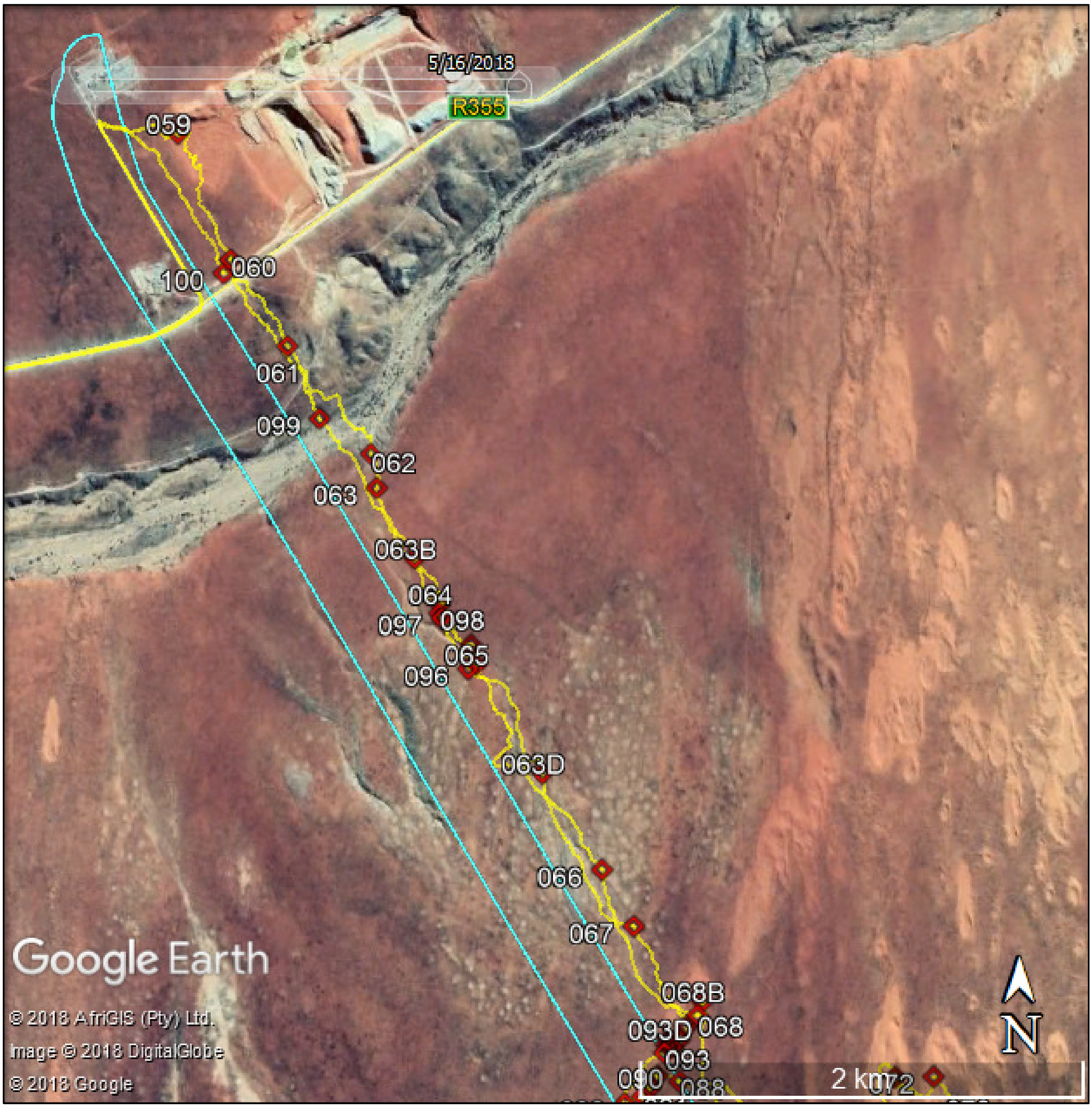


Figure A3.2: *Close up of area 1 (see caption for Figure A3.1).*

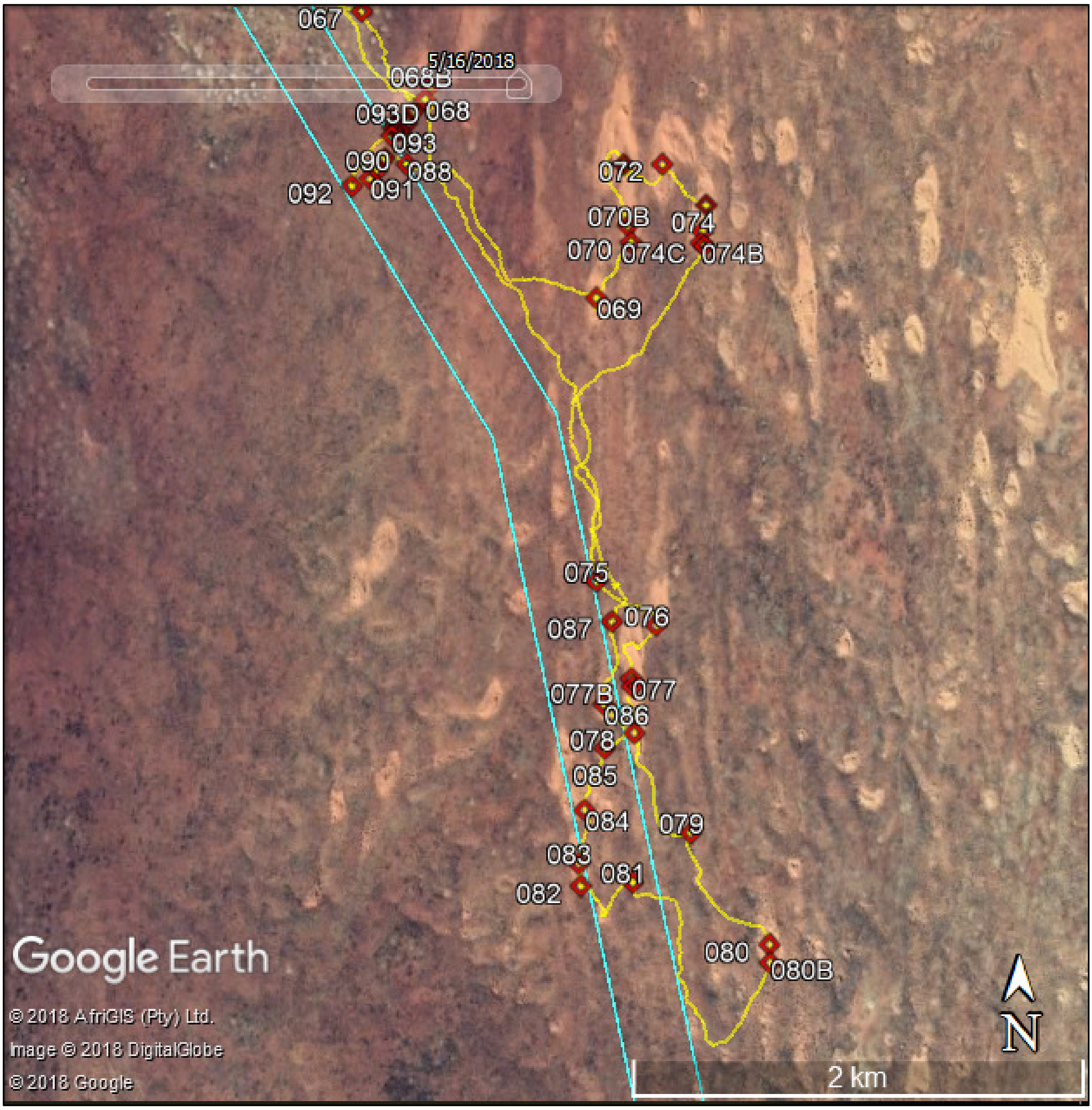


Figure A3.3: *Close up of area 2 (see caption for Figure A3.1). The Komaggas road crosses the northern part of this view.*

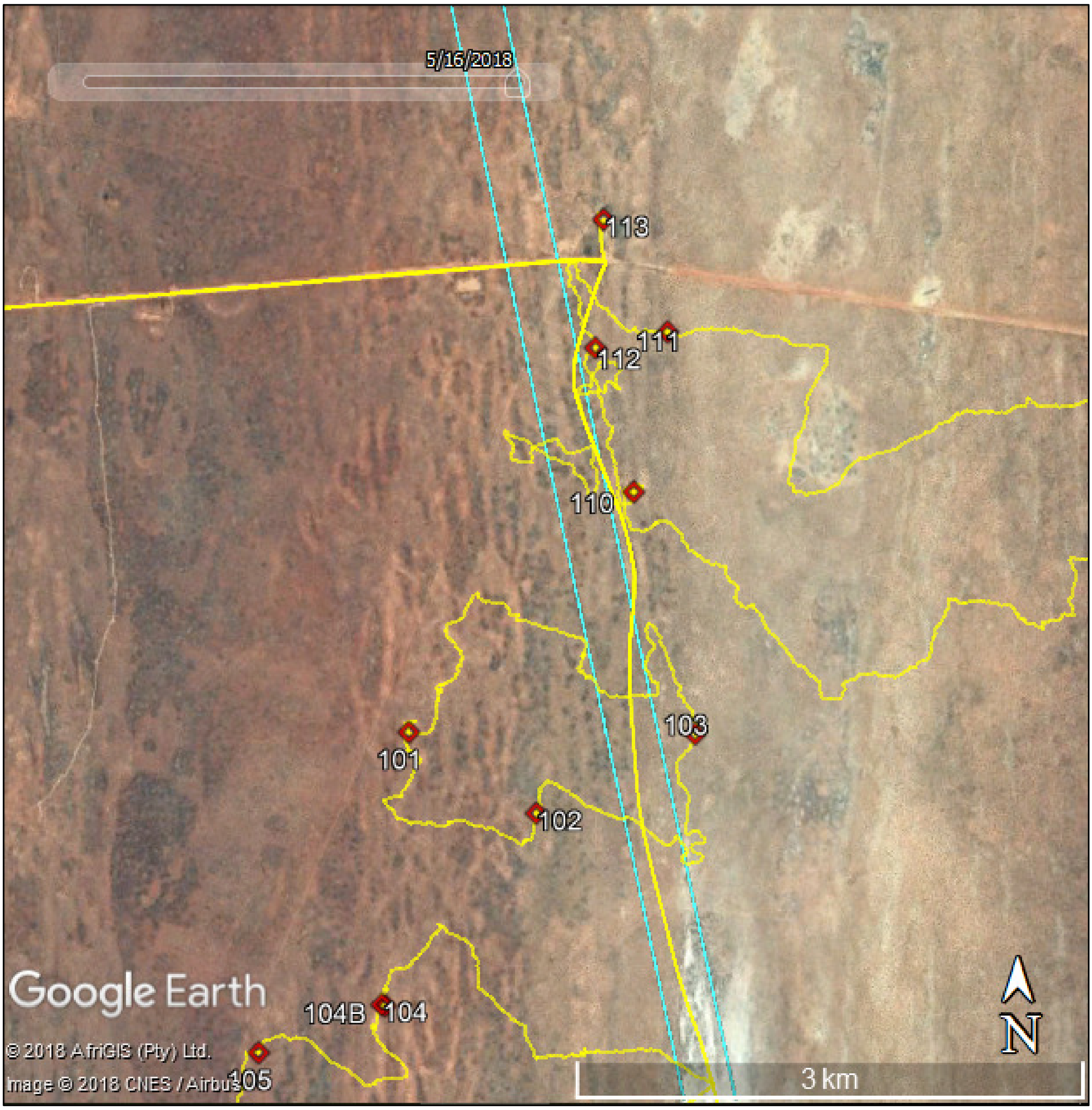


Figure A3.4: *Close up of area 3 (see caption for Figure A3.1).*

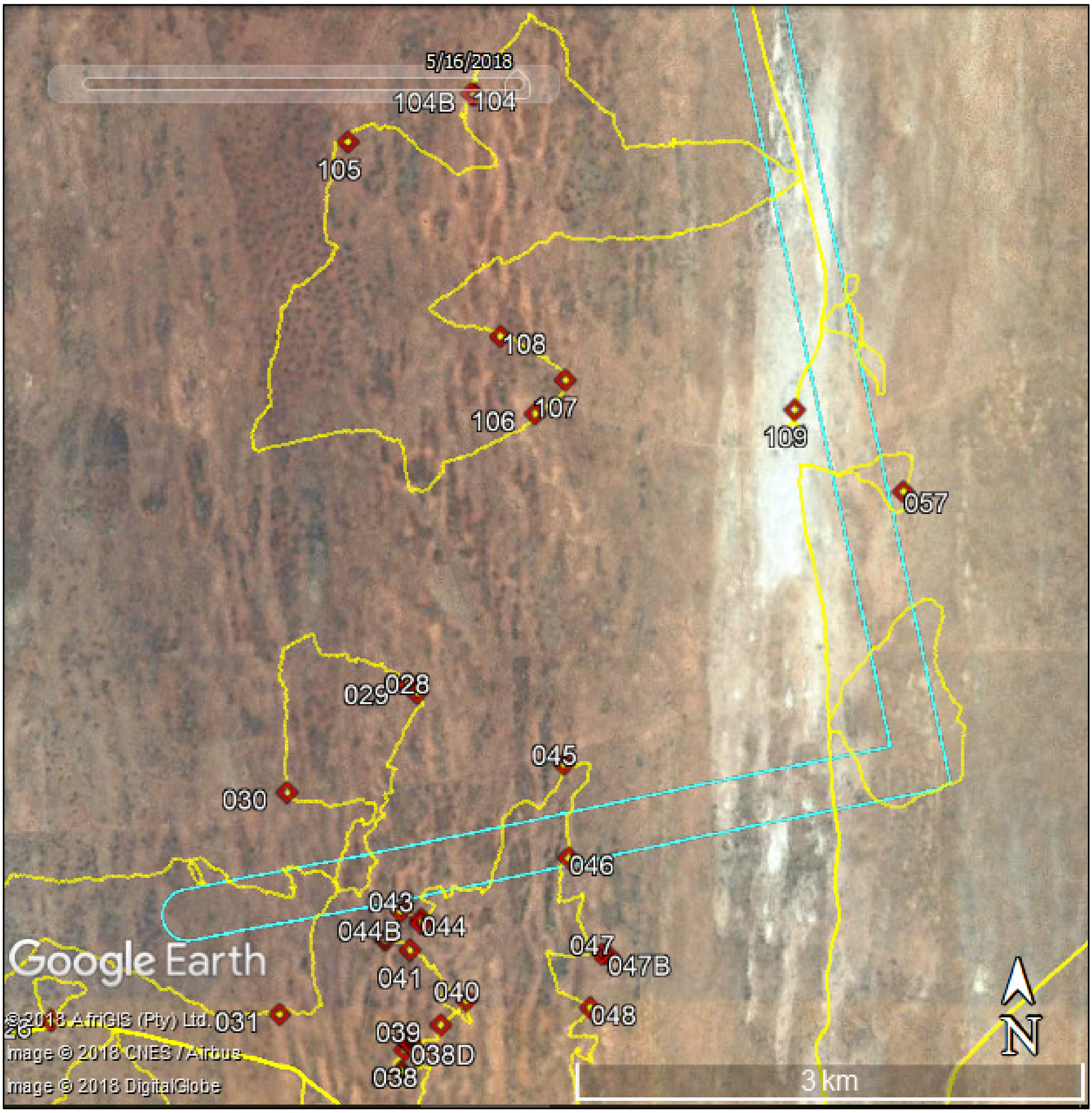


Figure A3.5: *Close up of area 4 (see caption for Figure A3.1).*

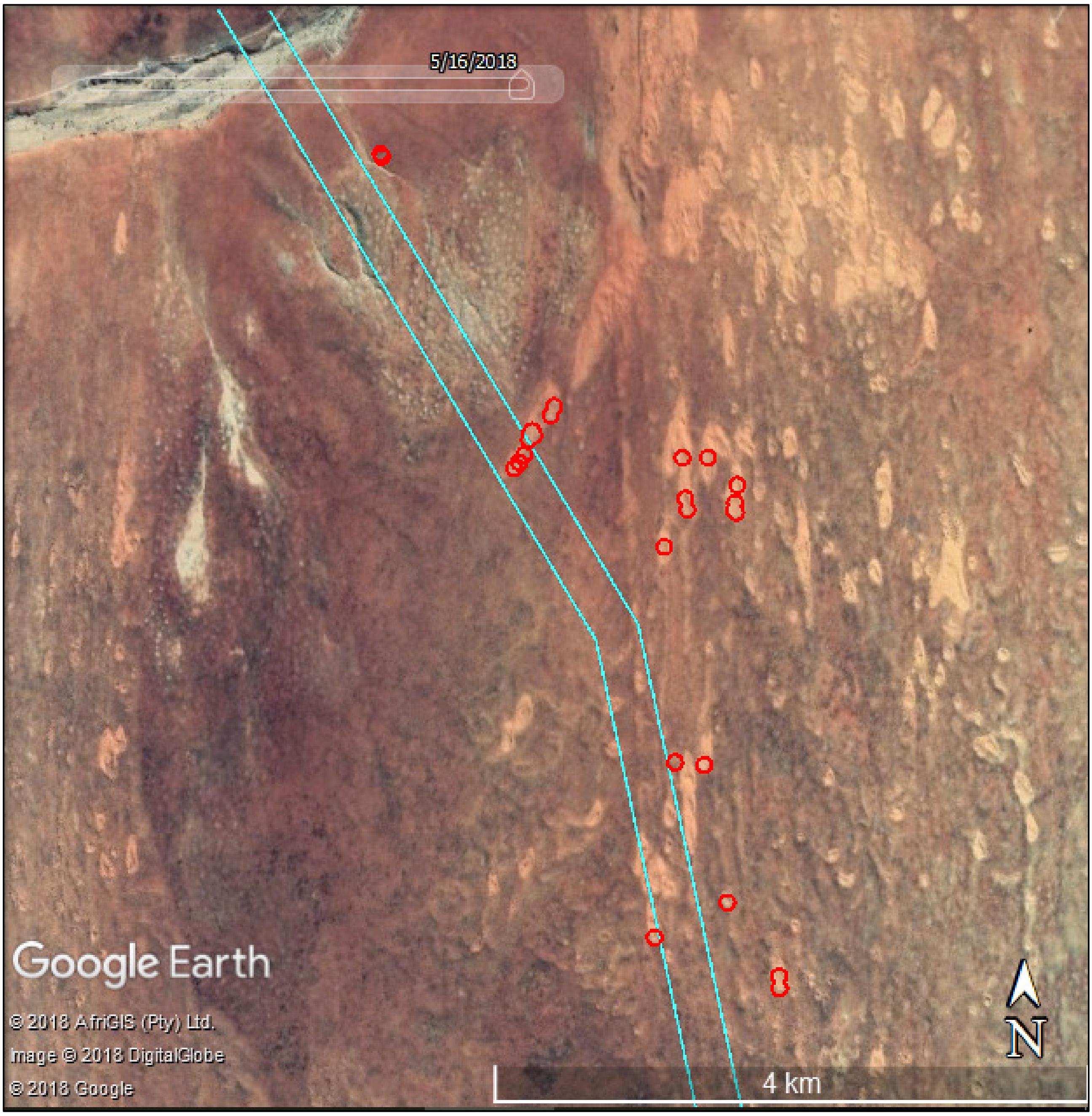


Figure A3.6: *Map showing 50 m buffers from the centre point of all significant archaeological sites (red circles) relative to the northern section of the 300m corridor.*

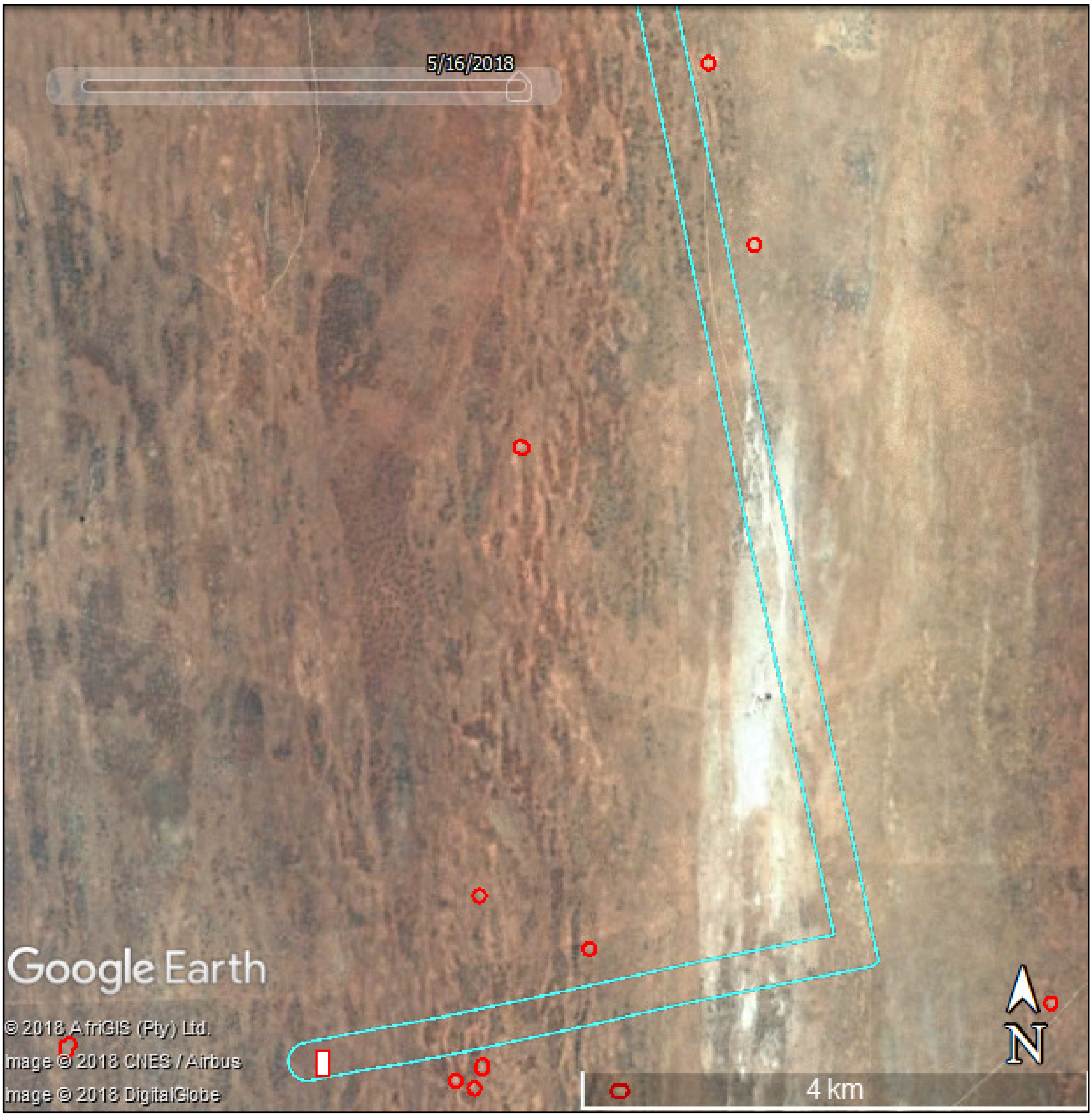
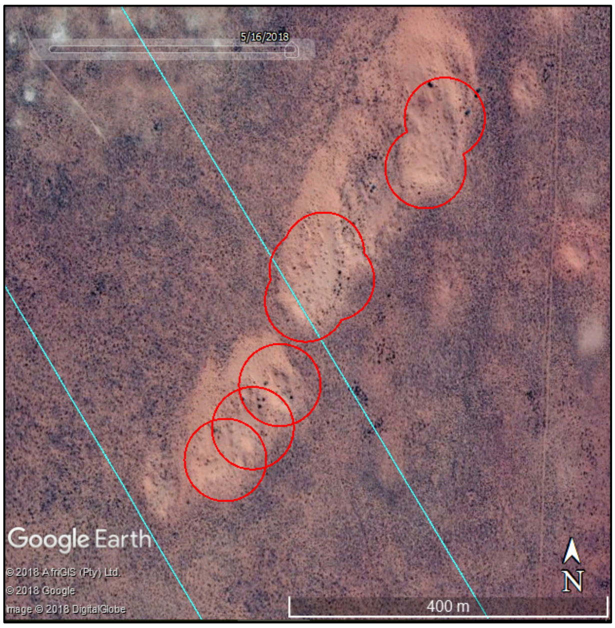


Figure A3.7: *Map showing 50 m buffers from the centre point of all significant archaeological sites (red circles) relative to the southern section of the 300m corridor (southern section) and collector substation (red polygon).*



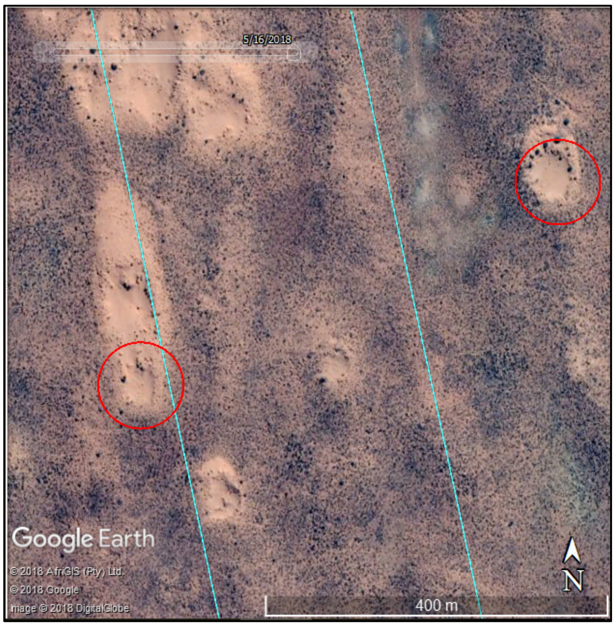


Figure A3.8: *Close-up of the main area where the 300m corridor intrudes on significant archaeological sites and their buffers.*

Figure A3.9: *Close up of the only other place where the power line corridor intrudes over the buffer of a significant archaeological site.*